SOIL SURVEY

Goshen County, Wyoming

Southern Part

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
WYOMING AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1947–1964. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service and the Wyoming Agricultural Experiment Station. It is part of the technical assistance furnished to the Lingle-Fort Laramie Soil and Water Conservation District, the South Goshen Soil and Water Conservation District, and the North Platte Valley Soil and Water Conservation Districts.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming and industry.

Locating Soils

All the soils of Goshen County, Wyoming, Southern Part, are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions in the section "Management of the Soils for Crops."

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Management of the Soils for Wildlife."

Ranchers and others can find under "Management of the Soils for Range" groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find under "Engineering Uses of the Soils" tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Goshen County, Wyoming, Southern Part, may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication.

Cover: Wind stripcropping on Manter and Anselmo fine sandy loams. The soils between the windbreak and the escarpment are a Mitchell silt loam and a Bordeaux fine sandy loam.

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SOIL SURVEY OF GOSHEN COUNTY, WYOMING, SOUTHERN PART

BY FRASER STEPHENS, ERNEST F. BRUNKOW, CHARLES J. FOX, AND HALVOR B. RAVENHOLT, SOIL CONSERVATION SERVICE[1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE WYOMING AGRICULTURAL EXPERIMENT STATION

GOSHEN COUNTY, SOUTHERN PART, is located in the southeastern part of Wyoming (fig. 1). It has a total area of 819,723 acres, or about 1,281 square miles. Torrington, the largest town, is the county seat of Goshen County.

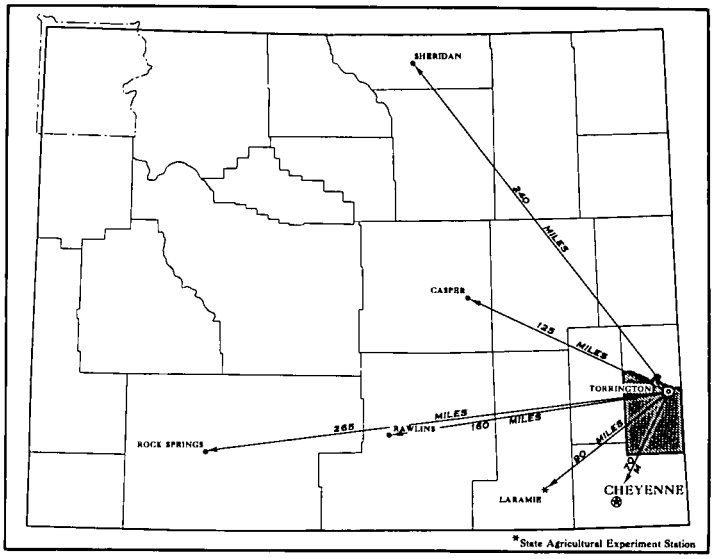

Figure 1.—**Location of Goshen County, Wyoming, Southern Part.**

The Survey Area is in the High Plains section of the Great Plains province. There are two subdivisions—the Western Nebraska and Eastern Wyoming Uplands and the Goshen Hole Lowland. The Survey Area is drained by the North Platte River and its tributaries. Sugar beets, corn, beans, potatoes, and alfalfa are the principal irrigated crops. Winter wheat is the principal dryland crop.

Much of the Survey Area is used for production of livestock, and many cattle and sheep are fattened for market on farms in the irrigated area.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Goshen County, Southern Part, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The categories of classification most used in a local survey are the *soil series* and the *soil phase (9)*.[2]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Satanta, for example, is the name of a soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Dwyer loamy fine sand, 0 to 3 percent slopes, is one of several phases within the Dwyer series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing

[1] Others who contributed to the survey are WALDO G. ELWONGER, HOWARD T. HOOD, JOHN E. IIAMS, HOWARD E. MCCOMAS, and GERALD L. RICHARD. ARVAD J. CLINE and HAROLD BINDSCHADLER assisted in the field correlation. All are soil scientists with the Soil Conservation Service or are soil scientists formerly on the staff of SCS.

[2] Italicized numbers in parentheses refer to Literature Cited, p. 95.

boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of this Survey Area; soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Colby-Tassel complex, 2 to 8 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Anselmo and Shingle soils, 10 to 15 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Dune land is a land type in the Survey Area.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

The soil scientists set up trial groups of soils on the basis of yield and practice tables and other data they have collected. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the southern part of Goshen County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not suitable for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The soil associations in the southern part of Goshen County are discussed in the following pages.

1. Satanta-Mitchell association

Deep, nearly level to sloping, well-drained, loamy soils on uplands

This association consists of wind-laid loams and silt loams that occur mainly near Veteran, west and southwest of Yoder, and near Huntley, but also on Table Mountain and in the western part of Goshen Hole. The elevation ranges from 4,100 to 4,500 feeet. Blue grama, western wheatgrass, and needle-and-thread are the dominant vegetation.

This association makes up about 9 percent of the Area. Satanta soils occupy about 42 percent of the association, and Mitchell soils, 31 percent. Keith and Ulysses soils are the minor soils.

Satanta soils have a surface layer of grayish-brown loam and a subsoil of grayish-brown to light-brown clay loam. Mitchell soils are loam or silt loam throughout the profile; the surface layer is light-brownish gray, and the underlying material is light gray.

About 53 percent of this association is used for dryland crops, about 22 percent for grazing, about 21 percent for irrigated crops, and about 4 percent for roads, townsites, and farmsteads.

2. Rosebud-Norka-Creighton association

Moderately deep to deep, nearly level to sloping, well-drained, loamy soils on uplands

This association consists of moderately deep loams and fine sandy loams and deep loams and very fine sandy loams. It occurs mainly on Harmony Heights, in the Iowa Center area, and south of Bear Creek. The elevation ranges from about 4,400 to 5,400 feet. Blue grama and needle-and-thread are the dominant vegetation.

This association makes up about 8 percent of the Area. Rosebud soils occupy about 29 percent of the association, Norka soils about 23 percent, and Creighton soils about 20 percent (fig. 2). Trelona and Colby soils are the principal minor soils.

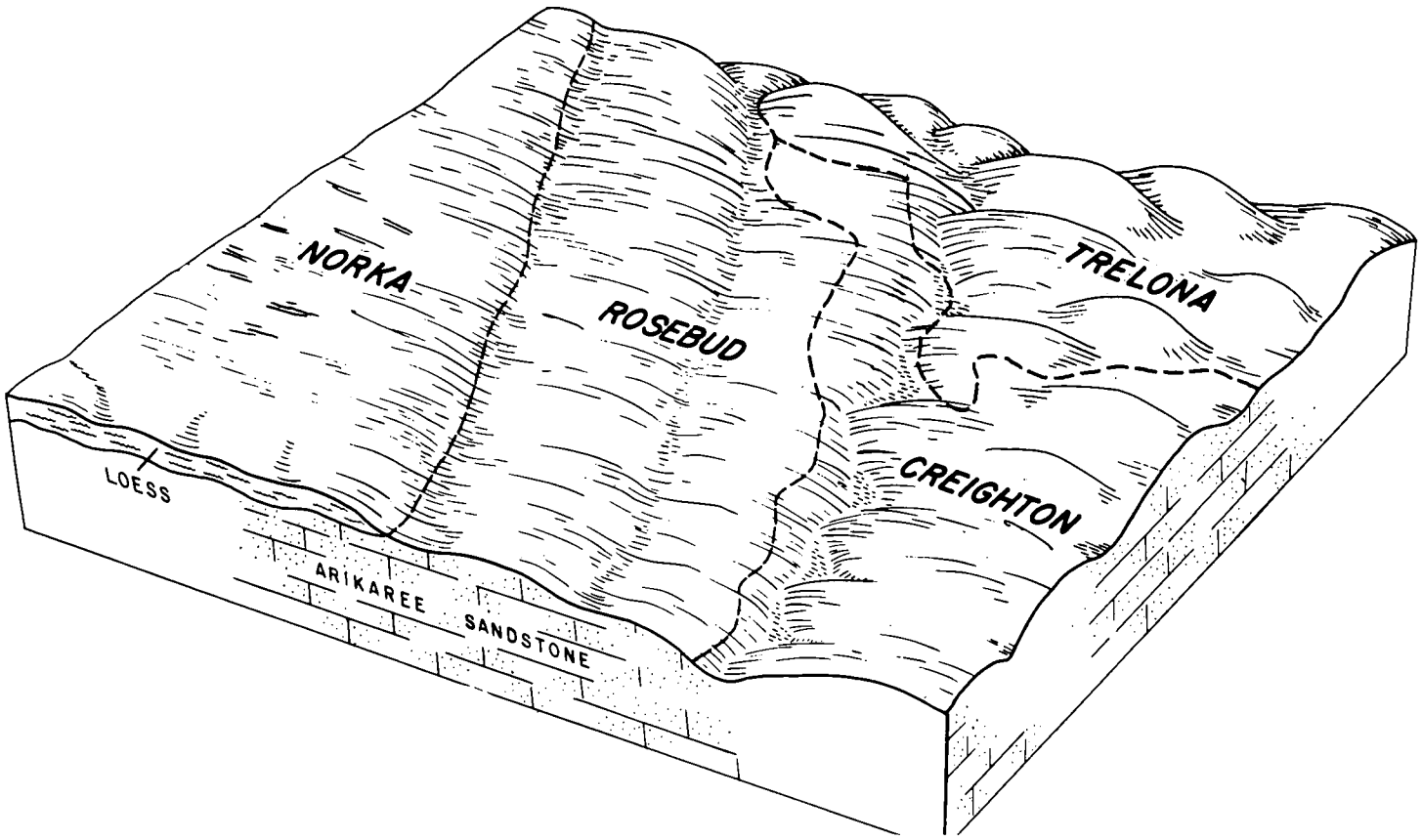

Figure 2.—**Typical pattern of soils, topography, and parent material in association 2.**

Rosebud soils are moderately deep. They have a surface layer of dark grayish-brown loam and fine sandy loam and a subsoil of dark-brown or brown sandy clay loam and very fine sandy loam. Norka soils are deep. They have a surface layer of grayish-brown loam and a subsoil of grayish-brown or brown clay loam. Creighton soils are deep. They are very fine sandy loam throughout the profile. The surface layer is grayish brown, and the subsoil is brown.

About 65 percent of this association is used for dryland crops, about 33 percent for native grass, and about 2 percent for roads and farmsteads. None of this association is irrigated.

3. *Anselmo-Manter-Dwyer association*

Deep, nearly level to sloping, well-drained to excessively drained, sandy and loamy soils on uplands

This association consists of wind-laid sands that occur mainly in an area that extends from LaGrange to Yoder but also as small areas in the west-central part of the Area. The elevation ranges from about 4,100 to about 4,850 feet but is predominantly between 4,200 and 4,600 feet. Blue grama and needle-and-thread are the dominant vegetation.

This association makes up about 21 percent of the Area. Anselmo soils occupy about 27 percent of the association, Manter soils about 20 percent, and Dwyer soils about 19 percent (fig. 3). The principal minor components are Alkali and saline land, Marsh and Wet land, and soils of the Bayard, Otero, and Vetal series.

Anselmo soils are well drained. They are sandy loam or fine sandy loam throughout. The surface layer and the underlying material are grayish brown. Manter soils also are well drained. The surface layer and the subsoil are grayish-brown fine sandy loam. Dwyer soils are excessively drained. The surface layer and the underlying material are light brownish-gray loamy fine sand.

About 67 percent of this association is used for grazing, about 17 percent for dryland crops, about 13 percent for irrigated crops, and about 3 percent for roads, townsites, and farmsteads.

4. *Dunday-Trelona-Dwyer association*

Deep to shallow, nearly level to steep, excessively drained to well-drained, sandy and loamy soils on uplands

This association consists of deep, nearly level to moderately steep, wind-laid sands and of shallow, gently sloping to steep sandy and loamy soils. This association occurs mainly in the western and southwestern parts of the Area, but also in the southeastern

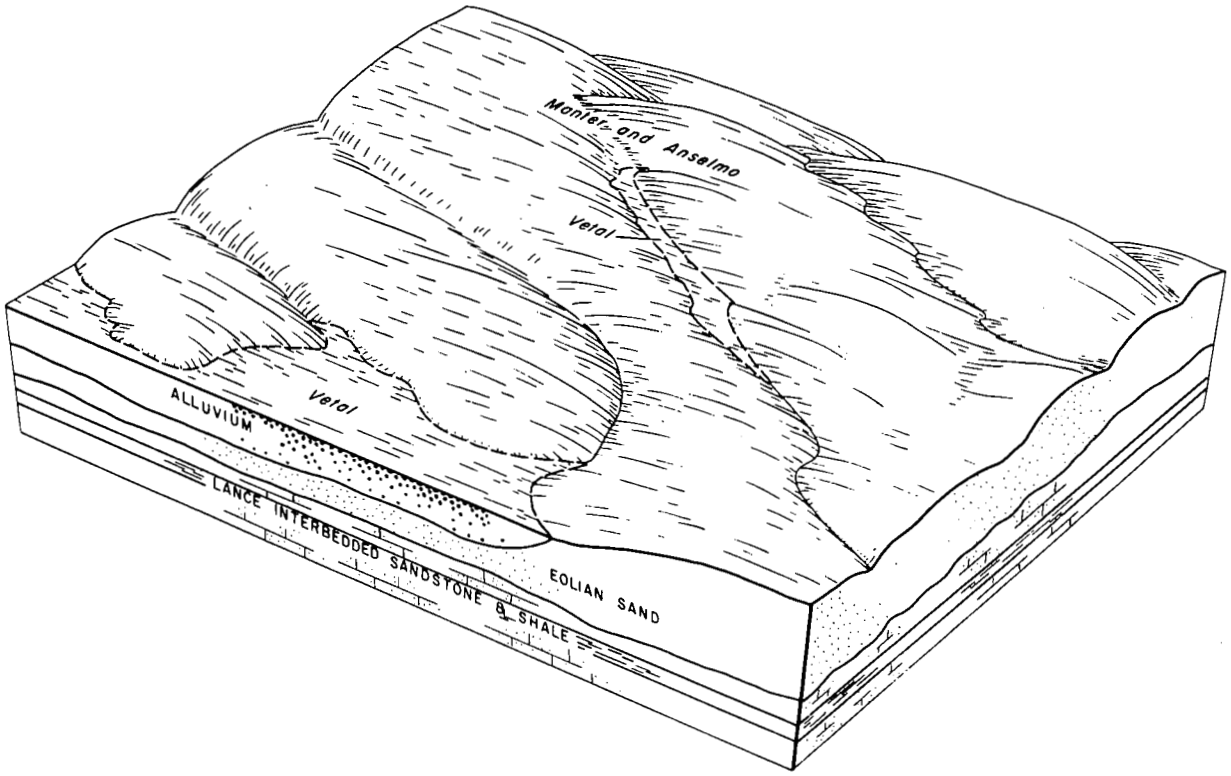

Figure 3.—**Typical relationship of Manter, Anselmo, and Vetal soils to topography and parent material in association 3.**

part. The elevation ranges from about 4,250 to about 5,660 feet. Blue grama, needle-and-thread, and prairie sandreed are the dominant vegetation.

The association makes up about 21 percent of the Area. Dunday soils occupy about 39 percent of the association, Trelona soils about 20 percent, and Dwyer soils about 13 percent. Rock outcrops and Tassel soils are the principal minor components.

Dunday soils are deep and excessively drained. The surface layer and the underlying material are grayish-brown loamy fine sand. Dwyer soils also are deep and excessively drained. The surface layer and the underlying material are light brownish-gray loamy fine sand. Trelona soils are shallow and well drained. The surface layer is grayish-brown fine sandy loam, and the underlying material is sandstone.

About 98 percent of this association is used for grazing, about 1 percent for dryland crops, and about 1 percent for roads, farmsteads, and ranch headquarters.

5. *Valentine-Dwyer association*

Deep, nearly level to steep, excessively drained sands on uplands

This association consists of wind-laid sands. It occurs mainly between the North Platte River bottoms and the Interstate Canal, but also southeast of Torrington and northeast of Hawk Springs. The elevation ranges from about 4,100 to 4,400 feet. Prairie sandreed and needle-and-thread are the dominant vegetation.

This association makes up about 6 percent of the Area. Valentine soils occupy about 44 percent of the association, and Dwyer soils about 43 percent. The principal minor soils are Dunday and Dix soils.

Valentine soils are fine sands. They have a brown surface layer and pale-brown underlying material. Dwyer soils are similar to Valentine soils, but they have a light brownish-gray surface layer and very pale brown underlying material that is limy at depths of less than 30 inches.

About 78 percent of this association is used for grazing, about 20 percent for irrigated crops, and about 2 percent for roads and farmsteads.

6. *Mitchell-Bordeaux-Epping association*

Predominantly deep, nearly level to moderately steep, well-drained, loamy soils on alluvial fans, foot slopes, and valley fills

This association consists partly of deep loams and sandy loams on nearly level to moderately steep fans and foot slopes and partly of shallow loams on nearly level to moderately steep uplands. It occurs mainly in

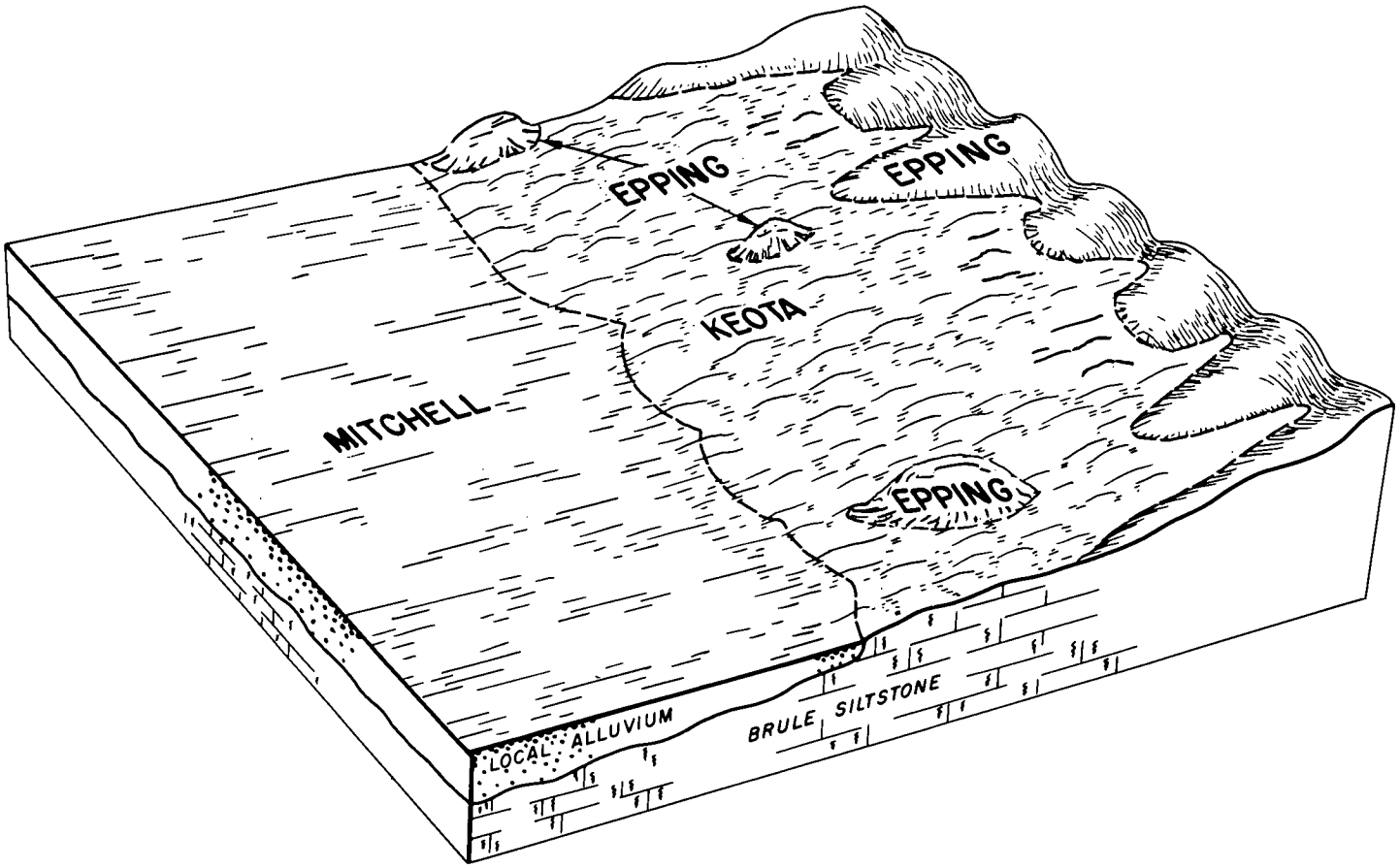

Figure 4.—**Typical relationship of Mitchell, Keota, and Epping soils to topography and parent material in association 6.**

an area that extends from the North Platte River to the southern part of the Area, but also in the eastern part of the Area. The elevation ranges from about 4,030 feet to about 5,000 feet. Blue grama, threadleaf sedge, and needle-and-thread are the dominant vegetation.

This association makes up about 25 percent of the Area. Mitchell soils occupy about 45 percent of the association, Bordeaux soils about 19 percent, and Epping soils about 11 percent (fig. 4). The principal minor soils are Keota soils.

Mitchell soils are deep. They are loam or silt loam throughout. The surface layer is light brownish gray, and the underlying material is light gray. The slopes range from nearly level to moderately steep.

Bordeaux soils are deep. They have a surface layer of grayish-brown fine sandy loam and underlying material of pale-brown loam. The slopes range from nearly level to sloping.

Epping soils are shallow. They are silt loam throughout. The surface layer is light brownish gray, and the underlying material is siltstone. The slopes are nearly level to moderately steep.

About 68 percent of this association is used for grazing, about 24 percent for dryland crops, about 7 percent for irrigated crops, and about 1 percent for roads and farmsteads.

7. *Kim-Orella-Heldt association*

Predominantly deep, nearly level to gently sloping, well-drained, loamy and clayey soils on alluvial fans, foot slopes, and valley fills

This association consists of deep, water-laid clays and clay loams on nearly level to sloping fans, foot slopes, and valley fills, and shallow clays on nearly level to gently sloping uplands. The principal area is in Cherry Creek Valley and includes a tongue that extends southeast into the broad flat west and northwest of Huntley. Smaller areas are in the eastern part of the Area and in the southwestern part of Goshen Hole. The elevation ranges from about 4,100 to 4,450 feet. Western wheatgrass is the dominant vegetation.

This association makes up about 5 percent of the Area. Kim soils occupy about 48 percent, Orella soils about 24 percent, and Heldt soils about 17 percent (fig. 5). The principal minor components are Epping soils and Alkali and saline land.

Kim soils are deep. They are clay loam throughout. The surface layer is light gray, and the upper part of the underlying material is light brownish gray. The slopes range from nearly level to sloping.

Orella soils are shallow. They are clay throughout. The surface layer is light gray, and the underlying

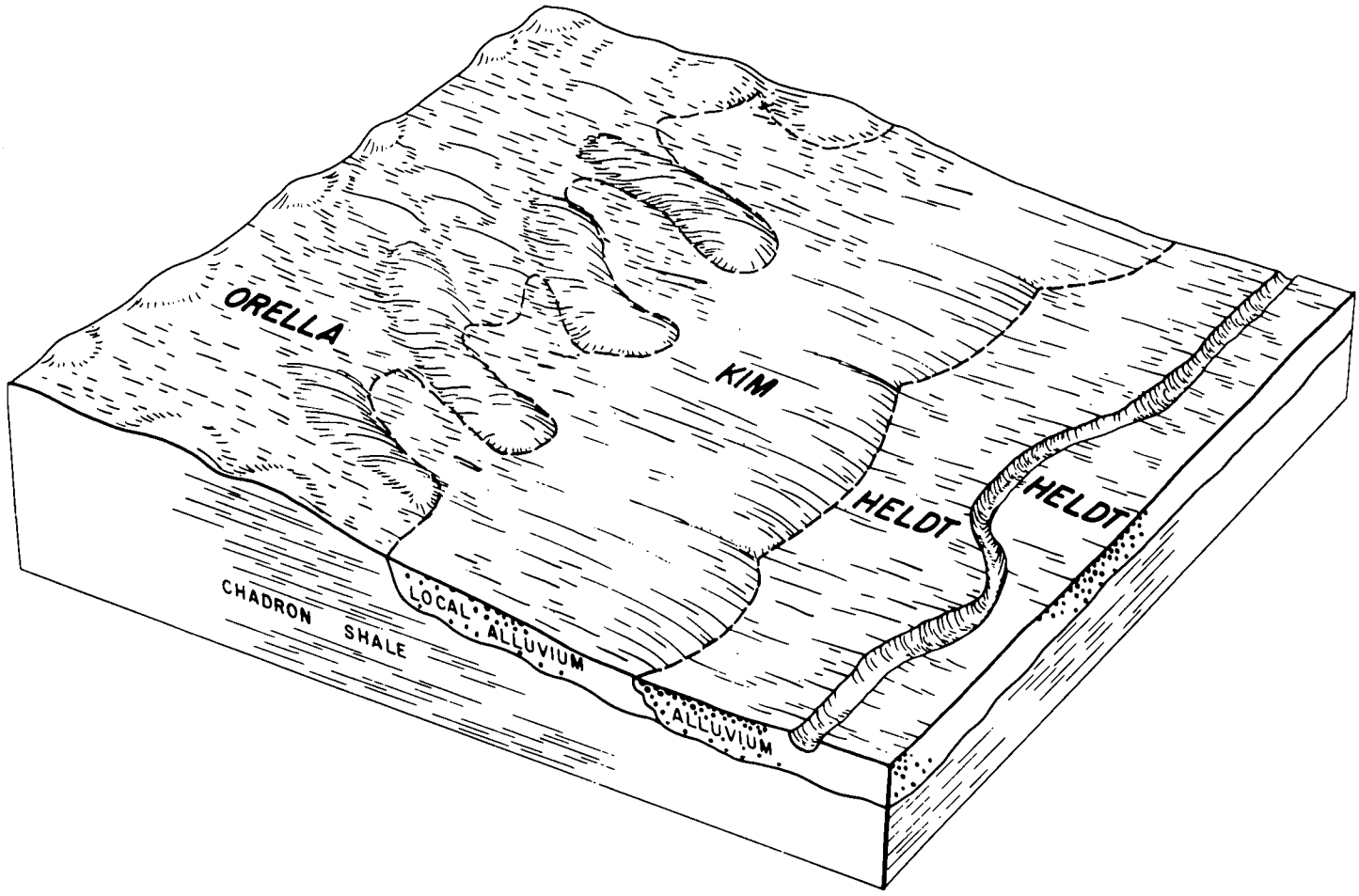

***Figure 5.*—Typical pattern of soils, topography, and parent material in association 7.**

material is light brownish gray. The slopes are nearly level to moderately steep.

Heldt soils are deep. They have a clay surface layer and a silty clay subsoil, both of which are light brownish gray. The slopes are nearly level.

About 69 percent of this association is used for grazing, about 23 percent for irrigated crops, about 6 percent for dryland crops, and about 2 percent for other purposes.

8. Haverson-Bankard association

Deep, nearly level to gently sloping, well-drained to excessively drained, loamy and sandy soils of the flood plains

This association consists of water-laid loams and sands that occur mainly along the North Platte and Laramie Rivers, but also along Rawhide Creek and Horse Creek near the Wyoming State line. The elevation ranges from about 4,025 to about 4,300 feet. Needle-and-thread and blue grama grasses and cottonwood trees are the dominant vegetation.

This association makes up about 5 percent of the Area. Haverson soils occupy about 37 percent of the association, and Bankard soils about 18 percent. Mixed alluvial land is a major component. McCook soils are important minor soils.

Haverson soils are well drained. The surface layer and the underlying material are light brownish-gray loam. The slopes are nearly level and very gently sloping. Bankard soils are excessively drained. The surface layer is grayish-brown loamy fine sand, and the underlying material is very pale brown fine sand or loamy fine sand. The slopes range from nearly level to gently sloping.

About 52 percent of this association is in native grass and trees and is used mostly for grazing. About 39 percent is used for irrigated crops, and about 9 percent for roads, railroads, townsites, and farmsteads.

Descriptions of the Soils

This section describes the soil series and mapping units of Goshen County, Southern Part. The approximate acreage and proportionate extent of the soils are given in table 1.

In the pages that follow, a general description of each soil series is given. Each series description has a

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Alkali and saline land	25,490	3.1
Anselmo fine sandy loam, 0 to 6 percent slopes	760	.1
Anselmo and Dwyer soils, 0 to 3 percent slopes	5,970	.7
Anselmo and Dwyer soils, 3 to 6 percent slopes	20,780	2.5
Anselmo and Dwyer soils, 6 to 10 percent slopes	5,630	.7
Anselmo and Dwyer soils, 10 to 15 percent slopes	1,100	.1
Anselmo and Shingle soils, 0 to 3 percent slopes	2,830	.3
Anselmo and Shingle soils, 3 to 10 percent slopes	11,410	1.4
Anselmo and Shingle soils, 10 to 15 percent slopes	1,770	.2
Anselmo-Trelona loamy fine sands, 0 to 3 percent slopes	890	.1
Ascalon fine sandy loam, 0 to 6 percent slopes	13,900	1.7
Ascalon fine sandy loam, 6 to 10 percent slopes	1,690	.2
Badlands	7,710	.9
Bankard loamy fine sand, 0 to 3 percent slopes	3,040	.4
Bankard loamy fine sand, 3 to 6 percent slopes	710	.1
Bayard fine sandy loam, 0 to 7 percent slopes	6,510	.8
Bayard and Otero fine sandy loams, 0 to 3 percent slopes	1,850	.2
Bayard and Otero fine sandy loams, 3 to 6 percent slopes	650	.1
Bordeaux fine sandy loam, 0 to 3 percent slopes	9,310	1.1
Bordeaux fine sandy loam, 3 to 6 percent slopes	21,420	2.6
Bordeaux fine sandy loam, 6 to 10 percent slopes	8,130	1.0
Chappell and Hawksprings fine sandy loams, 0 to 6 percent slopes	2,950	.4
Chappell and Hawksprings fine sandy loams, 6 to 10 percent slopes	5,270	.6
Chappell complex, 10 to 15 percent slopes	840	.1
Colby loam, 3 to 10 percent slopes	5,340	.6
Colby loam, 10 to 20 percent slopes	1,150	.1
Colby-Tassel complex, 2 to 8 percent slopes	1,890	.2
Creighton very fine sandy loam, 0 to 6 percent slopes	12,090	1.5
Creighton very fine sandy loam, 6 to 10 percent slopes	4,450	.5
Creighton very fine sandy loam, 10 to 20 percent slopes	1,980	.2
Dix complex, 0 to 10 percent slopes	1,000	.1
Dix complex, 10 to 40 percent slopes	8,700	1.1
Dunday and Dwyer loamy fine sands, 0 to 3 percent slopes	19,480	2.4
Dunday and Dwyer loamy fine sands, 3 to 10 percent slopes	25,430	3.1
Dunday-Trelona complex, 3 to 35 percent slopes	46,900	5.7
Dunday and Vetal loamy fine sands, 0 to 3 percent slopes	4,890	.6
Dunday and Vetal loamy fine sands, 3 to 10 percent slopes	1,380	.2
Dune land	690	.1
Duroc loam, 0 to 1 percent slopes	1,710	.2
Duroc loam, 1 to 3 percent slopes	870	.1
Dwyer loamy fine sand, 0 to 3 percent slopes	1,530	.2
Dwyer loamy fine sand, 3 to 10 percent slopes	4,640	.6
Dwyer and Mitchell soils, 10 to 15 percent slopes	1,700	.2
Epping silt loam, 0 to 6 percent slopes	8,960	1.1
Epping silt loam, 6 to 10 percent slopes	9,330	1.1
Epping silt loam, 10 to 15 percent slopes	2,390	.3
Glenberg fine sandy loam, 0 to 3 percent slopes	2,980	.4
Goshen-Kuma loams, 0 to 2 percent slopes	1,970	.2
Gullied land	4,040	.5
Haverson fine sandy loam, 0 to 3 percent slopes	4,240	.5
Haverson loam, gravel substratum variant, 0 to 3 percent slopes	840	.1
Haverson and McCook loams, 0 to 3 percent slopes	6,370	.8
Heldt clay, 0 to 3 percent slopes	8,020	1.0
Keith loam, 0 to 1 percent slopes	2,540	.3
Keith loam, 1 to 3 percent slopes	1,390	.2
Keith loam, 3 to 6 percent slopes	860	.1
Keota silt loam, 0 to 3 percent slopes	3,940	.5
Keota silt loam, 3 to 6 percent slopes	8,370	1.0
Keota-Epping silt loams, 6 to 15 percent slopes	4,900	.6
Kim clay loam, alkali, 0 to 1 percent slopes	15,030	1.8
Kim clay loam, alkali, 1 to 3 percent slopes	4,090	.5
Kim clay loam, alkali, 3 to 10 percent slopes	9,420	1.1
Marsh and Wet land, 0 to 5 percent slopes	7,100	.9
Manter and Anselmo fine sandy loams, 0 to 3 percent slopes	17,130	2.1
Manter and Anselmo fine sandy loams, 3 to 6 percent slopes	21,280	2.6
Manter and Anselmo fine sandy loams, 6 to 10 percent slopes	8,040	1.0
Mitchell-Shingle loams, 0 to 3 percent slopes	840	.1
Mitchell-Shingle loams, 3 to 10 percent slopes	4,240	.5
Mitchell silt loam, 0 to 3 percent slopes	44,130	5.4
Mitchell silt loam, 3 to 6 percent slopes	51,570	6.3
Mitchell silt loam, 6 to 10 percent slopes	12,050	1.5
Mitchell silt loam, 10 to 15 percent slopes	2,050	.3
Mixed alluvial land	12,840	1.6
Norka loam, 0 to 1 percent slopes	980	.1
Norka loam, 1 to 6 percent slopes	1,380	.2
Norka and Colby loams, 0 to 6 percent slopes	5,110	.6
Norka-Weld loams, 0 to 6 percent slopes	8,710	1.1
Norka-Weld loams, 6 to 10 percent slopes	850	.1
Orella clay, 0 to 3 percent slopes	8,920	1.1
Orella and Epping soils, 3 to 15 percent slopes	3,110	.4
Otero fine sandy loam, 0 to 3 percent slopes	4,320	.5
Otero fine sandy loam, 3 to 6 percent slopes	2,910	.4
Otero fine sandy loam, 6 to 10 percent slopes	1,270	.2
Rock land	61,980	7.5
Rock outcrop-Tassel complex	4,350	.5
Rosebud-Dunday-Trelona loamy fine sands, 0 to 3 percent slopes	4,690	.6
Rosebud-Dunday-Trelona loamy fine sands, 3 to 10 percent slopes	3,400	.4
Rosebud and Hargreave fine sandy loams, 0 to 6 percent slopes	10,520	1.3
Rosebud and Hargreave fine sandy loams, 6 to 10 percent slopes	3,010	.4
Rosebud and Norka loams, 0 to 1 percent slopes	700	.1
Rosebud and Norka loams, 1 to 6 percent slopes	9,360	1.1
Rosebud and Norka loams, 6 to 10 percent slopes	2,380	.3
Rosebud and Satanta loams, 0 to 3 percent slopes	1,770	.2
Rosebud-Trelona complex, 0 to 6 percent slopes	3,320	.4
Rosebud-Trelona fine sandy loams, 0 to 6 percent slopes	3,420	.4
Rosebud-Trelona fine sandy loams, 6 to 10 percent slopes	1,850	.2
Rosebud-Trelona fine sandy loams, 10 to 20 percent slopes	730	.1
Satanta fine sandy loam, 0 to 3 percent slopes	590	.1
Satanta loam, 0 to 1 percent slopes	9,060	1.1
Satanta loam, 1 to 3 percent slopes	3,070	.4
Satanta loam, 3 to 6 percent slopes	12,600	1.5
Satanta loam, 6 to 10 percent slopes	3,850	.5
Ulysses loam, 0 to 1 percent slopes	1,320	.2
Ulysses loam, 1 to 3 percent slopes	3,480	.4
Ulysses loam, 3 to 6 percent slopes	1,440	.2
Valentine and Dwyer fine sands, hilly	15,280	1.9
Valentine and Dwyer fine sands, rolling	26,670	3.2
Vetal fine sandy loam, 0 to 4 percent slopes	3,660	.5
Water	2,283	.3
Total	819,723	100.0

short narrative description of a typical profile and a much more detailed description of the same profile from which highly technical interpretations can be made. Following the profile is a brief statement of the range in characteristics of the soils in the series, as mapped in this Survey Area. Color names and color symbols given are for a dry soil, unless otherwise indicated.

Following the series description, each mapping unit in the series is described individually. For full information on any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit. The description of each mapping unit contains suggestions on how the soil can be managed under dryland farming and irrigation. Miscellaneous land types, such as Alkali and saline land, are described in alphabetic order along with other mapping units.

After the name of each mapping unit there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At the end of the description of each mapping unit are listed the capability unit, the range site, and the windbreak site in which the mapping unit has been placed. The pages where these interpretive groups are described can be learned readily by referring to the "Guide to Mapping Units."

For more general information about the soils, the reader can refer to the section "General Soil Map," in which the broad patterns of soils are described. Many of the terms used in the soil descriptions and other parts of the survey are defined in the Glossary.

Alkali and Saline Land

Alkali and saline land (Ak) consists of nearly level to gently sloping areas on flood plains, terraces, and foot slopes, and in upland swales. The soil texture ranges from loamy fine sand to clay loam. Alkali or soluble salts occur in all or part of the profile.

The concentration of alkali or soluble salts varies from place to place, but in all areas there is enough to restrict growth of most plants. Ground water is generally within the rooting depth of salt-tolerant plants during all or part of the growing season.

Surface runoff is slow, and water erosion is not a hazard. Wind erosion is a severe hazard in plowed areas.

These areas are suitable for hay and pasture, range, and wildlife habitat. When used for hay and pasture, use salt-tolerant species and manage the soil to maintain continuous cover. If irrigated, apply the proper kinds and amounts of fertilizer. Manage irrigation water properly to insure even distribution of water and to control waterlogging. In areas used for native pasture, good range management is needed to improve the stands and control grazing. Reclamation of deteriorated areas is difficult, and a detailed onsite investigation is needed to determine feasibility of reclamation. (Capability unit VIws–10, dryland or irrigated; not assigned to a range site or windbreak site)

Anselmo Series

The Anselmo series consists of deep, well-drained, nearly level to moderately steep soils on uplands, principally in the central and southeastern parts of the Area. These soils formed in wind-laid sandy material. The native vegetation is blue grama and needle-and-thread.

In a typical profile the surface layer is grayish-brown fine sandy loam about 17 inches thick. Below this is a 7–inch transitional layer, also of grayish-brown fine sandy loam. The underlying material to a depth of 40 inches or more is brown fine sandy loam that is high in lime content.

Permeability is moderately rapid, the available water capacity is moderate, and fertility is medium. Cultivation is easy.

Some areas are still in native grasses and are used for grazing. Others have been plowed and are used for dryland or irrigated crops. Crops respond to good soil management.

Typical profile of Anselmo fine sandy loam (1 percent slope) in a cultivated field, 450 feet north and 75 feet east of the SW. corner of the NW¼NE¼ sec. 8, T. 21 N., R. 60 W.:

A11—0 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; very weak, medium, subangular blocky structure that breaks to moderate to strong very fine granules; slightly hard, very friable; noncalcareous; pH 7.4; clear, smooth boundary.

A12—6 to 17 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure that breaks to moderate, medium, subangular blocky; slightly hard, very friable; noncalcareous; pH 7.4; clear, smooth boundary.

AC—17 to 24 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; slightly hard, very friable; noncalcareous; pH 7.8; gradual, wavy boundary.

Cca—24 to 40 inches +, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; weak ca horizon with some visible calcium carbonate that occurs as concretions and thin seams and streaks; calcareous; pH 8.2.

The A horizon ranges from fine sandy loam to loamy fine sand in texture, from 10 to 18 inches in thickness, and from grayish brown to dark grayish brown in color. The AC horizon and the Cca horizon range from fine sandy loam to sandy loam in texture.

Anselmo soils lack the B2t horizon of Manter soils. They have darker moist colors in the A horizon than Otero soils and a thinner A horizon than Vetal soils. They are finer textured throughout than Dwyer and Dunday soils, and they are deeper than Trelona soils. Anselmo soils are coarser textured and deeper than Shingle soils.

Anselmo fine sandy loam, 0 to 6 percent slopes (AlB).—This soil occurs on uplands in the western and southeastern parts of the Area. The surface layer is about 15 inches thick; otherwise, the profile is similar to the one described as typical for the series. Included in mapping were small areas of Dunday loamy fine sand and Trelona fine sandy loam.

Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

This soil is suited to range, dryland crops, windbreaks, and wildlife habitat. Most of the acreage is used for range. Habitat for sharp-tailed grouse, rabbit, antelope, and deer can be developed. No water is available for irrigation.

Winter wheat is the most suitable dryland crop. Oats, barley, and rye are suitable also. The major problems in managing dryland crops are conservation of moisture and control of wind erosion. To conserve moisture, leave fields fallow in alternate years. To control wind erosion, use a combination of wind stripcropping and stubble mulching. Ridges left by deep furrow drills also help to control wind erosion. (Capability unit IVe–5, dryland; Sandy range site; Sandy windbreak site)

Anselmo and Dwyer soils, 0 to 3 percent slopes (AmA).—Some areas of this unit consist of Anselmo fine sandy loam, some of Dwyer loamy fine sand, and some partly of each. These soils occur on uplands in the central and eastern parts of the Area. The profile of the Anselmo soil is like the profile described as typical for the Anselmo series. The profile of the Dwyer soil is similar to that described as typical for the Dwyer series, but the surface layer and the upper part of the underlying layer are loamy fine sand. Included in mapping were small areas of Manter fine sandy loam, Dunday loamy fine sand, and Vetal fine sandy loam.

Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe.

These soils are suited to dryland and irrigated crops, range, and farmstead windbreaks. They provide food and cover for wildlife, principally pheasant and rabbit.

Winter wheat is the most suitable dryland crop. Oats, rye, and barley are also suitable, and grain sorghum and sudangrass can be grown. The major problems of managing dryland crops are control of wind erosion and conservation of moisture. To control wind erosion, use wind stripcropping or a combination of wind stripcropping and stubble mulching. Ridges left by deep furrow drills also help. To conserve moisture, leave fields fallow in alternate years.

Alfalfa, alfalfa-grass mixtures, beans, corn, sugar beets, potatoes, and small grains are suitable irrigated crops. The major problems in managing irrigated cropland are uniform distribution of water, maintenance of fertility, structure, and organic-matter content, and control of wind erosion. To meet these problems, manage irrigation water properly, apply the right kinds and amounts of fertilizer, utilize crop residues, and include grasses and legumes in the rotation. (Anselmo part in capability unit IIIe–5, dryland, and IIe–5, irrigated. Dwyer part in capability unit IVe–4, dryland, and IIIe–4, irrigated. Both soils in Sandy range site; Sandy windbreak site)

Anselmo and Dwyer soils, 3 to 6 percent slopes (AmB).—Some areas of this unit consist of Anselmo fine sandy loam, some of Dwyer loamy fine sand, and some partly of each. The surface layer of the Anselmo soil is about 15 inches thick; otherwise, the profile of this soil is like the one described as typical for the Anselmo series. The profile of the Dwyer soil has a surface layer and an underlying layer of loamy fine sand but otherwise is similar to that described as typical for the series. Included in mapping were small areas of Manter fine sandy loam, Dunday loamy fine sand, and Otero fine sandy loam.

The hazard of water erosion is slight to moderate, and the hazard of wind erosion is severe.

These soils are suited to dryland and irrigated crops, windbreaks, and range. Tame grasses for hay or pasture are the most suitable dryland crops. Small grains can be grown also. Use wind stripcropping and stubble mulching to control wind erosion and to conserve moisture.

The irrigated crops commonly grown in this area are suitable. Erosion is the main hazard. Use contour furrows and runs of moderate length to distribute water evenly without intensifying the erosion hazard. Bench leveling and sprinkler irrigation would be suitable. (Anselmo part in capability unit IVe–5, dryland, and IIIe–5, irrigated; Sandy windbreak site. Dwyer part in capability unit VIe–4, dryland, and IVe–4, irrigated; Very Sandy windbreak site. Both soils in Sandy range site)

Anselmo and Dwyer soils, 6 to 10 percent slopes (AmC).—Some of these areas consist of Anselmo fine sandy loam, some of Dwyer loamy fine sand, and some partly of each. The surface layer of the Anselmo soil is about 12 inches thick; otherwise, the profile of this soil is like the one described as typical of the Anselmo series. The surface layer and the underlying material of the Dwyer soil are loamy fine sand; otherwise, the profile of this soil is similar to the one described as typical of the Dwyer series. Included in mapping were small areas of Manter fine sandy loam, Otero fine sandy loam, and Dunday loamy fine sand.

In cultivated areas surface runoff is medium, the hazard of water erosion is moderate, and the hazard of wind erosion is severe. Slope is a limitation for both dryland and irrigated crops.

Tame grasses for hay or pasture are the most suitable dryland crop. Small grains can be grown as a dryland crop also, but a combination of terraces, contour strips, and stubble mulching is needed to control erosion and conserve moisture. Small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. Use contour ditches or sprinkler irrigation to distribute water evenly and to help control water erosion. (Anselmo part in capability unit IVe–5, dryland, and IVe–5, irrigated; Sandy windbreak site. Dwyer part in capability unit VIe–4, dryland, IVe–4, irrigated; Very Sandy windbreak site. Both soils in Sandy range site)

Anselmo and Dwyer soils, 10 to 15 percent slopes (AmD).—Some of these areas consist of Anselmo fine sandy loam, some of Dwyer loamy fine sand, and some partly of each. Included in the areas mapped were small areas of Valentine and Dwyer fine sands.

In areas where these soils have been disturbed or are bare, the hazard of wind erosion is very severe, runoff is medium, and the hazard of water erosion is moderate to severe.

These soils are suited to range, irrigated hay and pasture, windbreaks, and wildlife food and cover. Alfalfa and alfalfa-grass mixtures are suitable irri-

gated crops. Use contour ditches or sprinklers and make frequent light applications of irrigation water to control erosion and insure even distribution of water. Keep in continuous cover to control wind erosion. (Anselmo part in capability unit VIe–5, dryland and irrigated; Sandy windbreak site. Dwyer part in capability unit VIe–4, dryland and irrigated; Very Sandy windbreak site. Both soils in Sandy range site)

Anselmo and Shingle soils, 0 to 3 percent slopes (AsA).—This unit occurs on uplands in the central part of the Survey Area. Some of these areas consist of Anselmo fine sandy loam, some of Shingle loam, and some partly of each. Included in mapping were small areas of Manter fine sandy loam, Vetal fine sandy loam, and Shingle fine sandy loam.

In cultivated areas the hazard of wind erosion is severe, runoff is slow, and the hazard of water erosion is slight.

This unit is suited to dryland and irrigated crops and to range. The Anselmo part is suitable for windbreaks. The Shingle part is generally not suitable for cultivation, but it can be farmed along with the rest of the unit. Wildlife habitat can be developed for rabbits, which are the principal game species, and for sharp-tailed grouse, antelope, and deer.

Winter wheat, oats, barley, and rye are suitable crops. Grain sorghum and sudangrass can be grown also. The major limitation in managing dryland is lack of moisture. To control wind erosion and conserve moisture, use wind stripcropping and stubble mulching.

Alfalfa, alfalfa-grass mixtures, corn, beans, and small grains are suitable irrigated crops. The moderate available water capacity is a limitation. The major problems in managing irrigated cropland are uniform distribution of water, maintenance of fertility, structure, and organic-matter content, and control of erosion. To meet these problems, manage irrigation water properly, apply the right kinds and amounts of fertilizer, use the crop residue, and include grasses and legumes in the rotation. (Anselmo part in capability unit IIIe–5, dryland and irrigated; Sandy range site; Sandy windbreak site. Shingle part in capability unit VIs–14, dryland and irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Anselmo and Shingle soils, 3 to 10 percent slopes (AsC).—Some of these areas consist of Anselmo fine sandy loam, some of Shingle loam, and some partly of each. The surface layer of the Anselmo soil in this unit is about 12 inches thick; otherwise, the profiles of these soils are like those described as typical of the series. Included in mapping were small areas of Shingle fine sandy loam, Manter fine sandy loam, and Otero fine sandy loam. Also included were a few small outcrops of sandstone and shale.

In cultivated areas surface runoff is medium, the hazard of water erosion is moderate, and the hazard of wind erosion is severe. Slope is a limitation for both dryland and irrigated crops.

These soils are suited to range, dryland hay and pasture, close-growing irrigated crops, and wildlife habitat. The Anselmo part is suitable for windbreaks.

Tame grasses for hay or pasture are the most suitable dryland crops. Small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. Use contour ditches or sprinklers to insure even distribution of water and to help control erosion. (Anselmo part in capability unit IVe–5, dryland and irrigated; Sandy range site; Sandy windbreak site. Shingle part in capability unit VIe–14, dryland and irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Anselmo and Shingle soils, 10 to 15 percent slopes (AsD).—Some of these areas consist of Anselmo fine sandy loam, some of Shingle loam, and some partly of each. Included in the areas mapped were small areas of Shingle fine sandy loam, Dwyer loamy fine sand, and several small areas of sandstone and shale outcrops.

In areas where these soils have been disturbed or are bare, the hazard of wind erosion is severe, runoff is medium to rapid, and the hazard of water erosion is severe.

These soils are suited to range, irrigated hay and pasture, and development of wildlife habitat. The Anselmo soil is suitable for windbreaks. On irrigated hay and pasture, use management practices that maintain a good vegetative cover. Use controlled flooding or sprinklers to insure even distribution of water and to help control water erosion. Use the right kinds and amounts of fertilizer to maintain fertility. (Anselmo part in capability unit VIe–5, dryland and irrigated; Sandy range site; Sandy windbreak site. Shingle part in capability unit VIIe–14, dryland, and VIe–14, irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Anselmo-Trelona loamy fine sands, 0 to 3 percent slopes (AtA).—This complex occurs on uplands in the southwestern part of the Survey Area. The Anselmo part makes up 60 to 70 percent of the acreage, and the Trelona part makes up 30 to 40 percent. Except for texture and thickness of the surface layer, the profiles are like those described as typical of the Anselmo and Trelona series. Included in mapping were small areas of Dunday loamy fine sand and a few small areas of sandstone outcrops.

In cultivated areas the hazard of wind erosion is very severe, runoff is slow, and the hazard of water erosion is slight. The principal limitation is lack of moisture.

This complex is suitable for range and can also be used for dryland crops. The Anselmo part is suitable for windbreaks. The Trelona part is generally not suitable for cultivation, but it can be farmed along with the rest of the complex. Wildlife habitat can be developed for rabbits, which are the principal game species, and for sharp-tailed grouse, pheasant, deer, and antelope.

Tame grasses for hay or pasture are the most suitable dryland crops. Winter wheat, oats, and barley can be grown also. If small grains are grown, use wind stripcropping and stubble mulching to conserve moisture and control wind erosion. (Anselmo part in capability unit IVe–4, dryland; Sandy range site; Sandy windbreak site. Trelona part in capability unit VIs–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Ascalon Series

The Ascalon series consists of deep, well-drained, nearly level to sloping soils on high terrace benches along Bear Creek. These soils formed in sandy alluvium. In some places the upper part of the alluvial material has been reworked by wind. The native vegetation consists of blue grama, needle-and-thread, and threadleaf sedge.

In a typical profile the surface layer is dark grayish-brown fine sandy loam about 7 inches thick. The uppermost 8 inches of the subsoil is dark grayish-brown fine sandy loam. Below this is about 12 inches of grayish-brown sandy clay loam. The lower part of the subsoil is light brownish-gray very fine sandy loam about 7 inches thick. The underlying material is light-gray very fine sandy loam grading to gravelly fine sandy loam. This material has a high content of lime.

Permeability and the available water capacity are moderate, and fertility is medium. Cultivation is easy.

Many areas are in native grasses and are used for grazing. Others have been plowed and are used for dryland crops. These soils are not irrigated, because irrigation water is not available. Crops respond to good management.

Typical profile of Ascalon fine sandy loam, 0 to 6 percent slopes, in an area of native range, 822 feet north and 85 feet west of the east quarter corner of sec. 28, T. 20 N., R. 63 W.:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable, slightly sticky; noncalcareous; pH about 7.0; clear, smooth boundary.

A3—4 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure breaking to very weak, medium, subangular blocky; soft to slightly hard, very friable, sticky; 10 to 15 percent fine gravel; noncalcareous; pH about 7.0; clear, smooth boundary.

B21t—7 to 15 inches, dark grayish-brown (10YR 4/2) fine sandy loam, dark brown (10YR 3/3) moist; weak, medium to coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard, very friable, sticky; thin, patchy clay films on peds; common fine pores; 5 to 10 percent fine gravel; noncalcareous; pH about 7.2; clear, smooth boundary.

B22t—15 to 22 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak to moderate, medium, prismatic structure breaking to weak to moderate, medium, subangular blocky; hard, friable, sticky; thin, continuous clay films on vertical faces and thin, patchy clay films on horizontal faces of peds; a few fine pores; 5 to 10 percent fine gravel; noncalcareous; pH about 7.3; gradual, smooth boundary.

B23t—22 to 27 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak to moderate, medium, subangular blocky structure; hard, friable, sticky; a few fine pores; 5 to 10 percent fine gravel; thin, patchy clay films on vertical faces of peds; noncalcareous; pH about 7.3; gradual, smooth boundary.

B3—27 to 34 inches, light brownish-gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; weak, medium, subangular blocky structure; hard, friable, sticky; common fine pores; noncalcareous; pH about 7.3; clear, smooth boundary.

C1ca—34 to 40 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, friable, sticky; 10 to 15 percent fine gravel; moderate calcium accumulation with much finely divided lime; strongly calcareous; pH about 8.4; gradual, wavy boundary.

C2ca—40 to 46 inches, light-gray (10YR 7/2) gravelly fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable, sticky; moderate calcium accumulation with much finely divided lime; strongly calcareous; pH about 8.4; gradual, wavy boundary.

C3ca—46 to 54 inches +, light-gray (10YR 7/2) gravelly fine sandy loam, light brownish gray (10YR 6/2) moist; massive; loose, very friable; weak to moderate calcium accumulation with much finely divided lime; strongly calcareous; pH about 8.4.

The A horizon ranges from 5 to 10 inches in thickness and from dark grayish brown to grayish brown in color. The gravel content varies throughout the profile but does not exceed 50 percent in any horizon.

Ascalon soils have more clay in the B2t horizon than Manter soils. They have a thinner A horizon than Vetal soils. They are finer textured throughout than Dunday soils.

Ascalon fine sandy loam, 0 to 6 percent slopes (AuB).—This soil occurs on high terrace benches along Bear Creek. It has the profile described as typical of the series. Included in mapping were small areas of Dunday loamy fine sand and of Manter fine sandy loam.

Runoff is slow, but there is a slight hazard of water erosion in cultivated areas. The hazard of wind erosion is severe.

This soil is suited to dryland crops, range, and windbreaks. No water is available for irrigation. Wildlife habitat can be developed. Rabbits and pheasants are the principal game species. There are also sharp-tailed grouse and antelope.

Winter wheat is the most suitable crop. Oats, barley, rye, and grasses are also suitable. Alfalfa, grain sorghum, and sudangrass can be grown but are less suitable than small grains. The major limitation is the shortage of moisture. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion. Ridges left by deep-furrow drills also help to control wind erosion. (Capability unit IIIe–5, dryland; Sandy range site; Sandy windbreak site)

Ascalon fine sandy loam, 6 to 10 percent slopes (AuC).—The surface layer of this soil is about 5 inches thick, and the subsoil is 12 to 15 inches thick; otherwise, the profile is like that described as typical of the series. Included in mapping were small areas of Dunday loamy fine sand.

In cultivated areas surface runoff is medium, the hazard of water erosion is moderate, and the hazard of wind erosion is severe. The slope and the lack of moisture are limitations for dryland crops.

This soil is suited to range, windbreaks, dryland crops, and wildlife habitat. If small grains are grown, terraces, contour strips, and stubble mulching are needed to conserve moisture and control erosion. (Capability unit IVe–5, dryland; Sandy range site; Sandy windbreak site)

Badlands

Badlands (Bd) consists mainly of areas of exposed siltstone, shale, and sandstone. In areas of siltstone and shale there is little or no soil material or vegetation. In areas of sandstone there is some soil material, but it covers less than 10 percent of the surface. Shallow gullies and small, smooth ridges form an intricate pattern in many places. Low buttes capped with channel sandstone occur in some areas.

Siltstone and shale weather fairly rapidly, and these areas can become partly vegetated if gullying is controlled and livestock is excluded. (Capability unit VIIIs–83, dryland; not assigned to a range site or windbreak site)

Bankard Series

The Bankard series consists of deep, excessively drained, nearly level to gently sloping soils on flood plains and low terraces. These soils occur principally along the North Platte and Laramie Rivers, but small areas are along Horse Creek and Bear Creek. They formed in sandy alluvium.

In a typical profile the upper part of the surface layer is grayish-brown loamy fine sand about 3 inches thick. The lower part is similar but is pale brown and about 6 inches thick. The next layer is very pale brown fine sand about 39 inches thick. This is underlain by very pale brown, stratified fine, medium, and coarse sand and gravel.

Permeability is rapid, the available water capacity is low, and fertility is low. Cultivation is easy. The hazard of wind erosion is very severe unless the soils are properly managed.

Some areas of Bankard soils are used for grazing, and some are used for irrigated crops. The native vegetation is needle-and-thread, blue grama, threadleaf sedge, and scattered cottonwoods.

Typical profile of Bankard loamy fine sand (1 percent slopes), in an area of native grasses, 250 feet north of the SE. corner of sec. 14, T. 25 N., R. 63 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; very weak, medium, crumb structure crushes to single grain; soft, very friable; calcareous; pH 8.4; clear, smooth boundary.

AC—3 to 9 inches, pale-brown (10YR 6/3) loamy fine sand, dark grayish brown (10YR 4/2) moist; very weak, medium, crumb structure crushes to single grain; soft, very friable; calcareous; pH 8.4; clear, smooth boundary.

C1—9 to 48 inches, very pale brown (10YR 7/3) fine sand, grayish brown (10YR 5/2) moist; single grain; loose, very friable; calcareous; pH 8.4; clear, smooth boundary.

C2—48 to 60 inches +, very pale brown (10YR 7/3), stratified fine, medium, and coarse sand and gravel, grayish brown (10YR 5/2) moist; single grain; loose; calcareous; pH 8.4.

The A1 and AC horizons range from 6 to 10 inches in thickness and from grayish brown or pale brown to light brownish gray or very pale brown in color. The C1 horizon ranges from fine sand to loamy fine sand in texture. Gravel occurs throughout the profile but does not make up more than 50 percent of any horizon within 40 inches of the surface.

Bankard soils are coarser textured throughout the profile than Glenberg and Haverson soils. They have a lighter colored A horizon and are coarser textured than McCook soils.

Bankard loamy fine sand, 0 to 3 percent slopes (BfA).—This soil occurs on flood plains along the North Platte and Laramie Rivers and along Horse Creek. It has the profile described as typical of the series. Included in mapping were small areas of Glenberg fine sandy loam, Haverson and McCook loams, and Mixed alluvial land.

This soil is well suited to range and wildlife habitat. It is suited to irrigated crops and windbreaks, and it can be used for dryland crops. Native grasses are used for grazing in many places. Pheasants and rabbits are the principal game species. There are also sharp-tailed grouse and deer. Most windbreaks are around farmsteads, but a few are along field borders.

Corn, alfalfa, alfalfa-grass mixtures, small grains, sugar beets, and potatoes are suitable irrigated crops. The low available water capacity is the major limitation. Use frequent, light applications to insure even distribution of irrigation water. To maintain fertility, preserve soil structure, and control wind erosion, use the crop residue, keep a cover crop on the soil, and use the right kinds and amounts of fertilizer.

The most suitable dryland crop is tame grasses, but small grains can also be grown. Lack of moisture is a severe limitation. If small grains are grown, use wind stripcropping and stubble mulching to conserve moisture and control wind erosion. (Capability unit IVe–4, dryland; IIIe–4, irrigated; Sandy Lowland range site; Sandy windbreak site)

Bankard loamy fine sand, 3 to 6 percent slopes (BfB).—Included in the areas mapped as this soil were small areas of Dwyer loamy fine sand.

In cultivated areas the hazard of wind erosion is very severe, runoff is slow, and the hazard of water erosion is slight.

This soil is suited to range, windbreaks, wildlife habitat, and irrigated crops.

Alfalfa, alfalfa-grass mixtures, and small grains are suitable irrigated crops. To insure even distribution of water and control water erosion, use contour furrows and frequent, light applications of irrigation water. (Capability unit VIe–4, dryland; IVe–4, irrigated; Sandy Lowland range site; Very Sandy windbreak site)

Bayard Series

The Bayard series consists of deep, well-drained, nearly level to gently sloping soils on terraces and fans. These soils occur principally along Horse Creek and the North Platte River; a few areas are on alluvial fans in the eastern part of the Survey Area. The soils formed in sandy alluvium.

In a typical profile the surface layer is grayish-brown fine sandy loam about 14 inches thick. The next layer is light brownish-gray fine sandy loam about 26 inches thick. It has a high content of lime. This layer is underlain by very pale brown fine sandy loam that has a high content of lime.

Permeability is moderately rapid, the available water capacity is moderate, and fertility is medium. Cultivation is easy.

Most areas of Bayard soils are used for crops. A few areas are used for grazing. The native vegetation is blue grama and needle-and-thread.

Typical profile of Bayard fine sandy loam, 0 to 7 percent slopes, in a cultivated field, 725 feet west and 270 feet south of the NE. corner of sec. 10, T. 19 N., R. 61 W.:

Ap—0 to 9 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; very weak, medium, subangular blocky structure breaking to weak, fine, crumb; slightly hard, very friable, slightly sticky; weakly calcareous; pH about 8.0; clear, smooth boundary.

A1—9 to 14 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure breaking to weak, fine, crumb; slightly hard, very friable, slightly sticky; a few fine pores; calcareous; pH about 8.4; clear, wavy boundary.

C1—14 to 40 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure breaking to weak, fine, crumb; slightly hard, very friable, slightly sticky; a few fine pores; some finely divided lime in thin streaks and seams; strongly calcareous; pH about 8.4; clear, wavy boundary.

C2—40 to 60 inches +, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft to slightly hard, very friable, slightly sticky; strongly calcareous; pH about 8.4.

The A horizon ranges from 10 to 18 inches in thickness and from grayish brown to dark grayish brown in color. In most places it is noncalcareous. The C horizon ranges from light brownish gray to very pale brown in color and from subangular blocky and crumb structure to massive.

When the soils are moist, Bayard soils are darker colored in the A horizon than Otero soils. The A horizon is thinner than that of Vetal soils.

Bayard fine sandy loam, 0 to 7 percent slopes (BgB).—This soil occurs mainly on flood plains along Horse Creek and the North Platte River, but there are a few areas on fans in the southeastern part of the Survey Area. It has the profile described as typical of the series. Included in mapping were small areas of Vetal fine sandy loam and Otero fine sandy loam.

Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe unless the soil is properly managed. The available water capacity is moderate.

This soil is suitable for irrigated and dryland crops, range, windbreaks, and wildlife habitat. It offers food and cover for wildlife, principally pheasants and rabbits but also deer and sharp-tailed grouse. Windbreaks are around farmsteads and along field boundaries.

The moderate available water capacity is the major limitation in managing irrigated areas. To manage irrigation water properly, use contour furrows, bench leveling, or sprinklers on gently sloping areas. To control erosion and maintain the organic-matter content, soil structure, and fertility, use cover crops and crop residue, include grasses and legumes in the rotation, and apply the right kinds and amounts of fertilizer. Ridging bare soil in fall helps to control wind erosion.

Winter wheat is the most suitable dryland crop, but other small grains are suitable also. Alfalfa, grain sorghum, and sudangrass can be grown but are less suitable than small grains. The major limitation in managing dryland is lack of moisture, and the principal hazard is wind erosion. To control wind erosion and conserve moisture use alternating strips of crops and stubble mulch. Ridges left by deep-furrow drills help to control wind erosion. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Sandy range site; Sandy windbreak site)

Bayard and Otero fine sandy loams, 0 to 3 percent slopes (BoA).—This unit occurs on nearly level stream terraces along Horse Creek. Some of these areas consist of Bayard fine sandy loam, some of Otero fine sandy loam, and some partly of each. The profiles are like those described as typical of the respective series. Included in mapping were small areas of Vetal fine sandy loam and Hawksprings fine sandy loam.

In cultivated areas the hazard of wind erosion is severe, runoff is slow, and the hazard of water erosion is slight.

This unit is suited to irrigated and dryland crops, range, windbreaks, and wildlife habitat. Windbreaks are mainly around farmsteads and along field boundaries. The principal wildlife species are pheasants, sharp-tailed grouse, rabbits, deer, and antelope.

Potatoes, sugar beets, corn, beans, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. The moderate available water capacity is a limitation. Use good management of irrigation water to insure even distribution of water. Use cover crops, crop residue, grasses and legumes in the rotation, and the right kinds and amounts of fertilizer to maintain organic-mater content, soil structure, and fertility, and to control erosion. Ridging bare soil in fall helps to control wind erosion.

Winter wheat is the most suitable dryland crop. Oats, rye, and barley are also suitable, and alfalfa, grain sorghum, and sudangrass can be grown. The major limitation is lack of moisture. Use alternating strips of crops and stubble mulch to conserve moisture and control wind erosion. The ridges left by deep-furrow drills help to control wind erosion. Native grasses are used for grazing in a few places, but good range management is needed to avoid overgrazing. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Sandy range site; Sandy windbreak site)

Bayard and Otero fine sandy loams, 3 to 6 percent slopes (BoB).—This unit is similar to Bayard and Otero fine sandy loams, 0 to 3 percent slopes, except for the slope. Included in mapping were small areas of Vetal fine sandy loam and Hawksprings fine sandy loam.

In cultivated areas runoff is slow to medium, the hazard of water erosion is slight to moderate, and the hazard of wind erosion is severe.

This unit is suited to irrigated crops, range, windbreaks, and wildlife food and cover. It can be used also for dryland crops.

The moderate available water capacity and the slope are the major limitations in managing irrigated crop-

land. Use contour furrows and irrigation runs of moderate length to insure even distribution of water and to control erosion. This unit is suited to bench leveling or sprinkler irrigation.

Tame grasses are the most suitable dryland crop, but small grains can also be grown. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion if small grains are grown. (Capability unit IVe–5, dryland; IIIe–5, irrigated; Sandy range site; Sandy windbreak site)

Bordeaux Series

The Bordeaux series consists of deep, well-drained, nearly level to sloping soils on fans and foot slopes. These soils are in Goshen Hole and in the valley of Bear Creek. They formed in alluvium and wind-laid material over water-laid loams.

In a typical profile the surface layer is grayish-brown fine sandy loam about 8 inches thick. The next layer is grayish-brown fine sandy loam about 10 inches thick. It has a moderate content of lime. The underlying material is pale-brown loam.

Permeability is moderately rapid and moderate, and the available water capacity is moderate. Fertility is medium, and cultivation is easy.

Many areas are used for grazing. Some areas are cultivated. The native vegetation is blue grama, needle-and-thread, and threadleaf sedge.

Typical profile of Bordeaux fine sandy loam, 0 to 3 percent slopes, in an area of native range, 90 feet north and 90 feet west of the south quarter corner of sec. 16, T. 24 N., R. 63 W.:

A1—0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, granular structure; soft, very friable; noncalcareous; pH 7.6; clear, smooth boundary.

C1ca—8 to 18 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; slightly hard, very friable; a weak ca horizon with visible calcium carbonate occurring mostly as small seams; calcareous; pH 8.2; abrupt, smooth boundary.

IIC2ca—18 to 60 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive or very weak, coarse, subangular blocky structure; slightly hard, very friable; 5 percent chips from Brule Formation; a weak ca horizon with visible calcium carbonate occurs as thin seams and streaks; calcareous; pH 8.4.

The A1 horizon ranges from grayish brown to dark grayish brown in color and from 7 to 15 inches in thickness. The lime content of the C1ca horizon ranges from moderate to almost none.

Bordeaux soils have a darker colored and coarser textured A horizon than Mitchell soils. When the soil is moist, the A horizon is darker colored than that of Otero soils. They have a finer textured C2 horizon than those soils.

Bordeaux fine sandy loam, 0 to 3 percent slopes (BrA).—This soil occurs on fans and foot slopes in the western and southeastern parts of the Survey Area. It has the profile described as typical of the series. Included in mapping were small areas of Mitchell silt loam and Otero fine sandy loam.

In cultivated areas surface runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is severe.

This soil is suitable for dryland and irrigated crops, range, windbreaks, and wildlife habitat. Sharp-tailed grouse, pheasants, rabbits, antelope, and deer find habitat. Native grasses are used for grazing in many places. Windbreaks are around farmsteads.

Winter wheat, oats, rye, and barley are suitable dryland crops. Lack of moisture is the principal limitation. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion. Ridges left by deep-furrow drills help to control wind erosion.

Corn, beans, potatoes, sugar beets, alfalfa, alfalfa-grass mixtures, and small grains are suitable irrigated crops. The moderate available water capacity is the major limitation. The major problems in managing irrigated cropland are uniform distribution of water, maintenance of fertility, structure, and organic-matter content, and control of erosion. To meet these problems, manage irrigation water properly, apply the right kinds and amounts of fertilizer, use the crop residue, and include grasses and legumes in the rotation. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Sandy range site; Sandy windbreak site)

Bordeaux fine sandy loam, 3 to 6 percent slopes (BrB).—Included in the areas mapped as this soil were small areas of Mitchell silt loam and Otero fine sandy loam. In cultivated areas runoff is slow to medium, the hazard of water erosion is slight to moderate, and the hazard of wind erosion is severe.

This soil is suitable for range, irrigated crops, windbreaks, wildlife food and cover, and dryland crops. Many areas are used for range.

The irrigated crops commonly grown are suited to this soil. The major limitations are moderate available water capacity and slope. Use contour furrows, bench leveling, or sprinklers along with good management of irrigation water to get even distribution of water and help control erosion.

The most suitable dryland crop is tame grasses. Winter wheat, oats, barley, and rye are also suitable. If small grains are grown, use a combination of wind stripcropping and stubble mulching to conserve moisture and control erosion. (Capability unit IVe–5, dryland; IIIe–5, irrigated; Sandy range site; Sandy windbreak site)

Bordeaux fine sandy loam, 6 to 10 percent slopes (BrC).—Included in the areas mapped as this soil were small areas of Mitchell silt loam, 6 to 10 percent slopes, and Otero fine sandy loam, 6 to 10 percent slopes. In cultivated areas, runoff is medium, the hazard of water erosion is moderate, and the hazard of wind erosion is severe.

This soil is suited to range, windbreaks, and wildlife habitat. It can be used for irrigated and dryland crops.

If this soil is irrigated, the principal limitations are the moderate available water capacity and the strong slope. It is suited to alfalfa, alfalfa-grass mixtures, and small grains. Use contour ditches and good management of irrigation water to insure even distribution of

water and control erosion. Sprinkler irrigation is suitable.

Tame grasses are the most suitable dryland crops. Winter wheat, oats, rye, and barley can be grown. Lack of moisture and the strong slope are the major limitations. If small grains are grown, use a combination of terraces, contour strips, and stubble mulching to control erosion and conserve moisture. (Capability unit IVe–5, dryland; IVe–5, irrigated; Sandy range site; Sandy windbreak site)

Chappell Series

The Chappell series consists of well-drained, nearly level to moderately steep soils on fans and foot slopes below high terrace rims along the North Platte River, Laramie River, Bear Creek, and Horse Creek. These soils formed in sandy and gravelly material washed from old, high terraces. The native vegetation consists of blue grama, needle-and-thread, and sand sagebrush.

In a typical profile the surface layer is grayish-brown or brown fine sandy loam about 8 inches thick. The next layer, about 10 inches thick, is similar except for a moderate content of lime. The upper part of the underlying material, about 14 inches thick, is fine sandy loam that grades to pale-brown gravelly fine sandy loam. This material has a moderate content of lime. It is underlain by loose sand and gravel.

Permeability is moderately rapid, and the available water capacity is moderate to low. Fertility is medium. Cultivation is easy, and the soils respond to good management.

Some areas are used for native range, and some are used for irrigated crops. A few areas are used for dryland crops.

Typical profile of Chappell fine sandy loam (9 percent slopes), in an area of native vegetation, 600 feet south and 330 feet east of the center of sec. 17, T. 25 N., R. 62 W.:

A11—0 to 2 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine to medium, crumb structure; soft, very friable; noncalcareous; pH about 7.2; clear, smooth boundary.

A12—2 to 8 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; very weak, medium, subangular blocky structure crushing to weak, fine, crumb structure; slightly hard, very friable; noncalcareous; pH about 7.4; gradual, boundary.

AC—8 to 18 inches, grayish-brown (10YR 5/2) fine sandy loam, dark brown (10YR 3/3) moist; very weak, medium, subangular blocky structure; soft to slightly hard, very friable; calcareous; pH about 8.2; clear, wavy boundary.

C1ca—18 to 24 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak, medium, subangular blocky structure crushing to single grain; soft to slightly hard, very friable; calcareous; pH about 8.2; clear, wavy boundary.

C2ca—24 to 32 inches, pale-brown (10YR 6/3) gravelly fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; crushing to single grain; slightly hard, very friable; calcareous; pH about 8.2; gradual, wavy boundary.

IIC3—32 to 48 inches, loose sand and gravel (60 to 70 percent gravel); calcareous.

The A horizon and the AC horizon combined range from 14 to 19 inches in thickness and from grayish brown or brown to dark grayish brown or dark brown in color. These horizons are gravelly in places. Loose sand and gravel occur at a depth ranging from 26 to 38 inches.

Chappell soils have a thinner A horizon than Hawksprings soils. They are less gravelly and are deeper to loose sand and gravel than Dix soils.

Chappell and Hawksprings fine sandy loams, 0 to 6 percent slopes (ChB).—This unit occupies fans and foot slopes below high terrace rims in the northern and southern parts of the Survey Area and stream terraces along the North Platte River. Some of these areas, consist of Chappell fine sandy loam, some of Hawksprings fine sandy loam, and some partly of each. The soils have the profiles described as typical of their respective series. Small areas of Vetal fine sandy loam and Dix gravelly fine sandy loam were included in mapping.

Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe if this unit is cultivated.

This unit is suited to range, dryland and irrigated crops, windbreaks, and wildlife habitat. Native grasses are used for grazing in many areas. Windbreaks are mainly around farmsteads. Pheasants, sharp-tailed grouse, rabbits, antelope, and deer find habitat.

Tame grasses for hay or pasture are the most suitable dryland crop. Winter wheat, oats, barley, and rye can be grown also. The major limitation is lack of moisture. If small grains are grown, use a combination of wind stripcropping and stubble mulching to control wind erosion and conserve moisture.

Alfalfa, alfalfa-grass mixtures, small grains, corn, beans, potatoes, and sugar beets are suitable irrigated crops. The principal limitations are the moderate to low available water capacity and the slope. Use good management of irrigation water, and, on the stronger slopes, use contour furrows or sprinklers to obtain even distribution of water and control water erosion. Use cover crops and crop residue, and include grasses and legumes in the rotation to control wind erosion and maintain the organic-matter content and soil structure. To maintain fertility, use the right kinds and amounts of fertilizer. (Capability unit IVe–5, dryland; IIIe–5, irrigated; Sandy range site; Sandy windbreak site)

Chappell and Hawksprings fine sandy loams, 6 to 10 percent slopes (ChC).—This unit occupies fans and foot slopes below high terrace rims in the northern and southern parts of the Survey Area. Some of these areas consist of Chappell fine sandy loam, some of Hawksprings fine sandy loam, and some partly of each. Small areas of Dix gravelly fine sandy loam, Dwyer loamy fine sand, and Otero fine sandy loam were included in mapping.

In cultivated or disturbed areas, runoff is medium, the hazard of water erosion is moderate, and the hazard of wind erosion is severe.

This unit is suited to range, windbreaks, wildlife food and cover, and close-growing irrigated crops.

Alfalfa, alfalfa-grass mixtures, and small grains are suitable irrigated crops. The slope and the moderate to

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low available water capacity are the major limitations. Use contour ditches and good management of irrigation water to insure even distribution of water and help control water erosion. Sprinkler irrigation is suitable. (Capability unit VIe–5, dryland; IVe–5, irrigated; Sandy range site; Sandy windbreak site)

Chappell complex, 10 to 15 percent slopes (ClD).—This complex occupies foot slopes in the northern and southern parts of the Survey Area. About 50 to 80 percent of the acreage consists of Chappell fine sandy loam, and about 20 to 50 percent of Dix gravelly fine sandy loam. Except that the surface layer of the Chappell soil is about 14 inches thick, these soils have the profiles described as typical of their respective series. Included in mapping were small areas of Dwyer loamy fine sand and Otero fine sandy loam. Also included were small areas of Hawksprings fine sandy loam.

Runoff is medium to rapid, and the hazard of both water and wind erosion is severe if the soils are disturbed.

This complex is suited to range and wildlife habitat. It can be used for irrigated hay or pasture, and the Chappell part can be used for windbreaks. Nearly all the acreage is used for range. Pheasants, sharp-tailed grouse, rabbits, antelope, and deer find habitat.

The slope limits the choice of irrigated plants to perennial grasses or grass and legume mixtures. Use management practices that will maintain good stands for long periods. Use controlled flooding or sprinklers to obtain even distribution of water and help control water erosion. Use the right kinds and amounts of fertilizer to maintain fertility. (Chappell part in capability unit VIe–5, dryland and irrigated; Sandy range site; Sandy windbreak site. Dix part in capability unit VIIe–6, dryland; Gravelly range site; Unsuitable windbreak site)

Colby Series

The Colby series consists of deep, well-drained, very gently sloping to moderately steep soils on uplands. These soils are in the southern part of the Survey Area. They formed in wind-laid loams. The native vegetation consists of blue grama and threadleaf sedge.

In a typical profile the surface layer is light brownish-gray loam about 5 inches thick. It is high in content of lime. This layer is underlain by pale-brown loam that also is high in content of lime.

Colby soils are easy to work. They are low in fertility and are subject to severe wind erosion. Permeability is moderate, and the available water capacity is high.

Most of the acreage is in native vegetation and is used for grazing. Part is used for dryland crops. None of the acreage is irrigated.

Typical profile of Colby loam (4 percent slopes) in a cultivated field, SE¼NE¼NE¼ sec. 14, T. 21 N., R. 65 W.:

Ap—0 to 5 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; slightly hard, very friable; many roots; strongly calcareous; pH about 8.4; abrupt, smooth boundary.

AC—5 to 26 inches, pale-brown (10YR 6/3) loam, brown, (10YR 5/3) moist; weak, medium, prismatic structure to weak, medium, subangular blocky in the upper 9 inches; weak, medium, subangular blocky structure in the lower 12 inches; hard, very friable; many fine pores; much finely divided lime in streaks and seams; roots common; strongly calcareous; pH about 8.4; gradual, wavy boundary.

C—26 to 63 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; very weak, medium, subangular blocky structure; slightly hard, very friable; many fine pores; strongly calcareous; pH about 8.4.

The Ap horizon ranges from 2 to 6 inches in thickness and from light brownish gray or pale brown to grayish brown or brown in color. The AC horizon ranges from 10 to 22 inches in thickness. The C horizon ranges from very weak subangular blocky structure to massive.

Colby soils have a lighter colored A horizon than Keith and Norka soils and do not have the B2t horizon that is typical of those soils. They are finer textured and deeper than Tassel soils. They resemble Mitchell soils but differ in mineralogy.

Colby loam, 3 to 10 percent slopes (CoC).—This soil has the profile described as typical for the Colby series. Included in mapping were small areas of Norka and Ulysses loam.

In cultivated areas runoff is medium to rapid, the hazard of water erosion is moderate to severe, and the hazard of wind erosion is severe.

This soil is suited to range, dryland crops, windbreaks, and wildlife habitat, particularly habitat for sharp-tailed grouse, rabbits, antelope, and deer. No water is available for irrigation.

Native grasses are used for grazing on a large part of the acreage. Tame grasses for hay or pasture are the most suitable dryland crops. Small grains can also be grown. The principal limitations are lack of moisture and slope. If small grains are grown, use wind stripcrops and stubble mulch on the gentle slopes and a combination of terraces, contour strips, and stubble mulch on the steeper slopes to control erosion and conserve moisture. (Capability unit IVe–3, dryland; Limy Upland range site; Silty to Clayey windbreak site)

Colby loam, 10 to 20 percent slopes (CoD).—This soil has the profile described as typical for the Colby series except that the surface layer is about 2 inches thick. Included in mapping were small areas of Dix gravelly fine sandy loam and Epping silt loam, 10 to 15 percent slopes. In disturbed areas, runoff is rapid and the hazard of water and wind erosion is severe.

This soil is suited to range, windbreaks, and wildlife food and cover. Almost all the acreage is used for range. (Capability unit VIe–3, dryland; Limy Upland range site; Silty to Clayey windbreak site)

Colby-Tassel complex, 2 to 8 percent slopes (CtC).—This complex consists of Colby loam and Tassel fine sandy loam. The Colby part makes up 60 to 80 percent of the acreage, and the Tassel part makes up 20 to 40 percent. Each soil has the profile described as typical for the respective series. Included with this complex in mapping were small areas of Creighton very fine sandy loam, Rosebud loam, and Trelona fine sandy loam.

Runoff is medium to rapid. In cultivated areas, the

hazard of water erosion is moderate to severe and the hazard of wind erosion is severe.

These soils are suited to range, dryland crops, and wildlife habitat, particularly habitat for pheasants, sharp-tailed grouse, rabbits, antelope, and deer. The Colby soil is also suited to windbreaks. The Tassel soil is generally not suited to cultivation, but it can be farmed along with the Colby soil in order to maintain field alinement.

Slope and lack of moisture are limitations if this complex is used for dryland crops. Small grains can be grown, but tame grasses for hay or pasture are more suitable. If small grains are grown, use strip crops and a stubble mulch that contains the maximum amount of crop residues to help control erosion and conserve moisture. Contour strips on the steeper slopes help in controlling water erosion. (Colby part in capability unit IVe–3, dryland; Limy Upland range site; Silty to Clayey windbreak site. Tassel part in capability unit VIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Creighton Series

The Creighton series consists of deep, well-drained, nearly level to moderately steep soils on uplands. These soils developed in material weathered in place from soft sandstone. They occur in the northwestern and southwestern parts of the Survey Area. The native vegetation is needle-and-thread, western wheatgrass, blue grama, and buffalograss.

In a typical profile the surface layer is grayish-brown very fine sandy loam about 10 inches thick. The subsoil is brown very fine sandy loam about 10 inches thick. The underlying material is very fine sandy loam that grades from very pale brown to light brownish gray. This material is high in content of lime.

Creighton soils are fertile and are easy to cultivate. They are subject to severe wind erosion if mismanaged. Permeability is moderate, and the available water capacity is high.

A large acreage is still in native vegetation and is used for grazing. Some areas are used for dryland crops. No water is available for irrigation.

Typical profile of Creighton very fine sandy loam, 0 to 6 percent slopes, in an area of native range near the NE. corner of SE1/4NW1/4 sec. 21, T 19 N., R. 64 W.:

A11—0 to 6 inches, grayish-brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, granular structure; soft, very friable; noncalcareous; pH 7.2; clear, smooth boundary.

A12—6 to 10 inches, grayish-brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure breaking to moderate fine granules; hard, very friable; noncalcareous; pH 7.2; clear, smooth boundary.

B2—10 to 20 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure breaking to moderate, coarse, subangular blocky; hard, very friable; a few thin patchy clay films on some peds; noncalcareous; pH 7.6; gradual, wavy boundary.

C1ca—20 to 30 inches, very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive or very weak, coarse, subangular blocky structure; hard, very friable; weak to moderate ca horizon containing visible secondary calcium carbonate that occurs as concretions and thin seams and streaks; calcareous; pH 8.2; gradual, wavy boundary.

C2ca—30 to 50 inches +, light brownish-gray (2.5Y 6/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; very weak ca horizon containing a very small amount of visible secondary calcium carbonate occurs as small concretions; calcareous; pH 8.4.

The A horizon ranges from 7 to 15 inches in thickness and from grayish brown to dark grayish brown in color. The B horizon ranges from 8 to 15 inches in thickness. Soft bedrock occurs below a depth of 40 inches.

Creighton soils have less clay in the B horizon and are deeper than Rosebud and Hargreave soils. They are deeper than Trelona soils. They are deeper than Tassel soils and if moist, have darker colors in the A horizon than those soils.

Creighton very fine sandy loam, 0 to 6 percent slopes (CvB).—This soil is on tableland in the western and southwestern parts of the Survey Area. It has the profile described as typical for the Creighton series. Included in mapping were small areas of Rosebud fine sandy loam and Trelona fine sandy loam.

Runoff is slow to medium. In cultivated areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion is severe.

This soil is suited to dryland crops, range, windbreaks, and wildlife habitat, particularly habitat for pheasants, sharp-tailed grouse, rabbits, antelope, and deer.

Winter wheat is the most suitable dryland crop. Oats, rye, and barley are also suitable. Lack of moisture is the principal limitation. Use wind stripcropping and stubble mulching to control erosion and conserve moisture. Vary the depth of plowing to prevent the development of a plow pan. (Capability unit IIIe–5, dryland; Loamy range site; Sandy windbreak site)

Creighton very fine sandy loam, 6 to 10 percent slopes (CvC).—Except for slope and an 8–inch surface layer, this soil is similar to Creighton very fine sandy loam, 0 to 6 percent slopes. Included in mapping were small areas of Rosebud fine sandy loam, Trelona fine sandy loam, and Tassel fine sandy loam.

In cultivated areas, runoff is medium to rapid and the hazard of water and wind erosion is severe.

This soil is suited to range, windbreaks, wildlife food and cover, and dryland crops. Tame grasses are well suited. If small grains are grown, use a combination of terraces, contour strips, and stubble mulch to control erosion and conserve moisture. (Capability unit IVe–5, dryland; Loamy range site; Sandy windbreak site)

Creighton very fine sandy loam, 10 to 20 percent slopes (CvD).—This soil is on tableland in the western and southwestern parts of the Survey Area. The surface layer is about 7 inches thick, and the depth to lime is about 15 inches; otherwise, this soil is similar to Creighton very fine sandy loam, 0 to 6 percent slopes. Included in mapping were small areas of Dunday loamy fine sand, Trelona fine sandy loam, and Tassel fine sandy loam.

Runoff is rapid. In areas where this soil is disturbed or the vegetative cover is destroyed, the hazard of water and wind erosion is severe.

This soil is suitable for range, windbreaks, and wildlife habitat particularly habitat for sharp-tailed grouse, rabbits, deer, and antelope. Most of the acreage is used for range. (Capability unit VIe–5, dryland; Loamy range site; Sandy windbreak site)

Dix Series

The Dix series consists of well-drained to excessively drained, gently sloping to steep soils on terrace rims in the northern and southern parts of the Survey Area. These soils developed in very gravelly alluvium. The native vegetation is blue grama, needle-and-thread, threadleaf sedge, sagewort, and cactus.

In a typical profile the surface layer is grayish-brown gravelly fine sandy loam about 3 inches thick. The next layer is dark-brown gravelly fine sandy loam about 4 inches thick. Below this is brown and light-gray gravelly sand and very gravelly sand.

Dix soils have rapid permeability and a low available water capacity. They are not suitable for cultivation, but they provide sand and gravel for construction purposes. There are numerous gravel pits.

Typical profile of Dix gravelly fine sandy loam (20 percent slopes) in an area of native range 600 feet SW. of the NE. corner of SW¼NE¼ sec. 17, T. 25 N., R. 62 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; noncalcareous; pH about 7.6; clear, smooth boundary.

AC—3 to 7 inches, dark-brown (10YR 4/3) gravelly fine sandy loam, dark brown (10YR 3/3) moist; very weak, medium, subangular blocky structure breaking to weak, fine, crumb; soft to slightly hard, very friable; noncalcareous; pH about 7.4; clear, wavy boundary.

C1—7 to 13 inches, brown (10YR 5/3) gravelly sand, dark grayish brown (10YR 4/2) moist; single grain; loose, dry, and moist; noncalcareous; pH about 7.4; clear, wavy boundary.

IIC2—13 to 48 inches +, light-gray (10YR 7/2), loose very gravelly sand.

The A1 horizon ranges from 2 to 6 inches in thickness and from grayish brown to dark grayish brown in color. The AC horizon ranges from 4 to 6 inches in thickness. The depth to lime ranges from a few inches to more than 30 inches.

Dix soils have a thinner A horizon and are shallower over loose sand and gravel than Chappell and Hawksprings soils.

Dix complex, 0 to 10 percent slopes (DcD).—This complex occupies high terraces above the North Platte River, the Laramie River, Horse Creek, and Bear Creek. It is 60 to 70 percent Dix gravelly fine sandy loam and 30 to 40 percent Chappell fine sandy loam, Dunday loamy fine sand, and Valentine and Dwyer fine sands. The profile of each soil is similar to the one described as typical for the respective series. Included in mapping were small areas of gravelly and very gravelly soils that are shallow over soft bedrock.

Runoff is slow to medium; the gravel in the surface layer helps to slow down runoff. In disturbed areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion is severe.

This complex is suitable for range and for wildlife habitat, particularly habitat for sharp-tailed grouse, rabbits, deer, and antelope. Almost all the acreage is used for range. There are several small sand and gravel pits. (Capability unit VIe–6, dryland; Gravelly range site; Unsuitable windbreak site)

Dix complex, 10 to 40 percent slopes (DcE).—This complex occupies high terrace rims (fig. 6) above the flood plains of the North Platte River, the Laramie River, Horse Creek, and Bear Creek. It is 50 to 80 percent Dix gravelly fine sandy loam and 20 to 50 percent Valentine and Dwyer fine sands and loamy fine sands. The profile of each soil is similar to the one described as typical for the respective series. Included in mapping were small areas of Chappell fine sandy loam, Epping silt loam, and Tassel fine sandy loam, and of very gravelly soils that are shallow over soft bedrock.

Runoff is rapid to very rapid. The gravel in the surface layer tends to slow runoff and retard erosion. In areas where the vegetation is destroyed or the soil is disturbed, the hazard of water and wind erosion is severe.

This complex is suited to range and to wildlife habitat, particularly habitat for rabbits, antelope, and deer. There are several small sand and gravel pits. (Dix part in capability unit VIIe–6, dryland; Gravelly range site. Valentine and Dwyer parts in capability unit VIIe–15, dryland; Choppy Sands range site. All soils in Unsuitable windbreak site)

Dunday Series

The Dunday series consists of deep, excessively drained, nearly level to moderately steep soils that developed in wind-laid sands on uplands and in water-laid sands on fans and foot slopes. These soils occur in many parts of the Survey Area. The native vegetation consists of blue grama, needle-and-thread, prairie sandreed, and sagebrush.

In a typical profile the surface layer is grayish-brown loamy fine sand about 16 inches thick. Below this is grayish-brown loamy fine sand.

Dunday soils are easy to work but are low in natural fertility. Permeability is rapid, and the available water capacity is low.

Many areas are still in native vegetation and are used for grazing. Some areas are used for dryland and irrigated crops. Crops respond well to good management.

Typical profile of Dunday loamy fine sand (3 percent slopes) in an area of native range, NE¼SW¼SW¼SE¼ sec. 2, T. 20 N., R. 63 W.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; noncalcareous; pH about 7.0; clear, smooth boundary.

A12—3 to 16 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure breaking to weak, fine, crumb; slightly hard, very

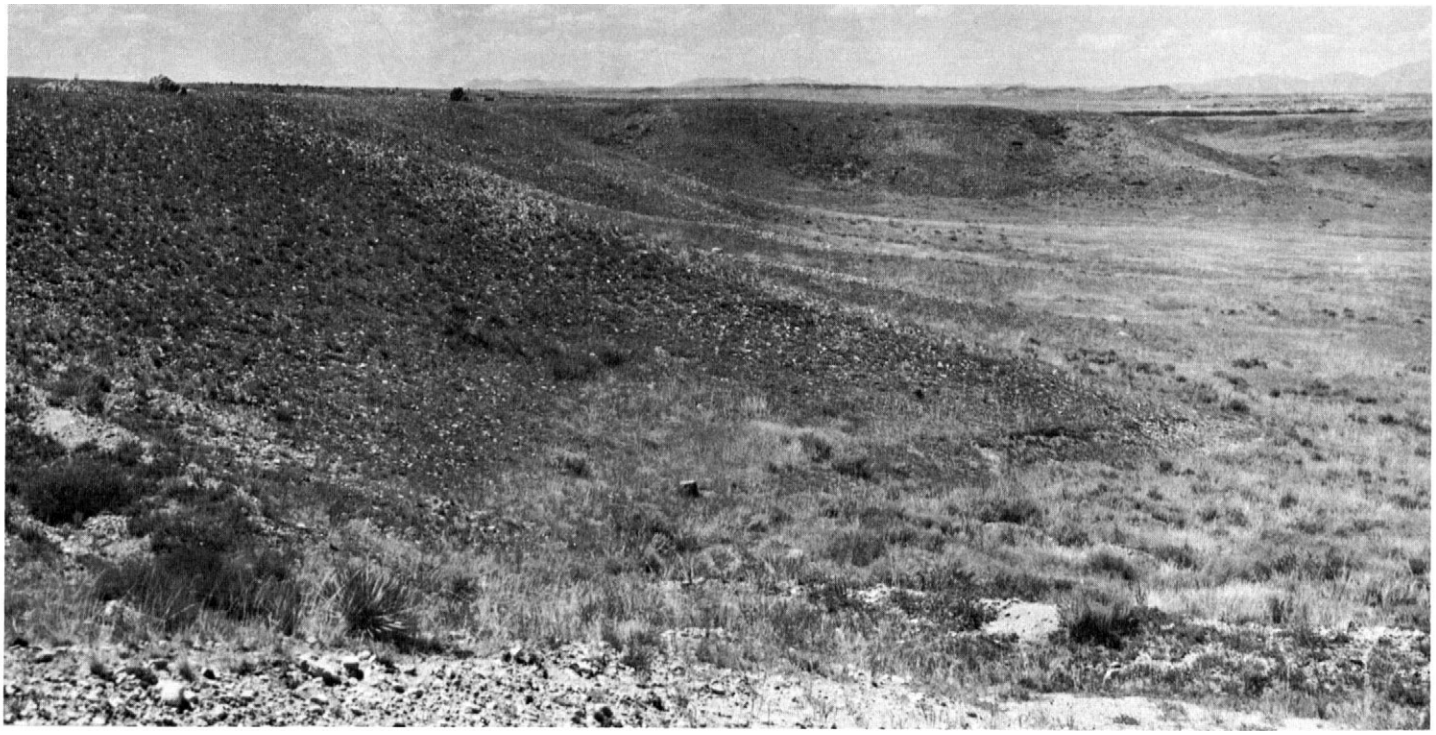

Figure 6.—**Short steep slopes of high terrace rims. The soil is Dix complex, 10 to 40 percent slopes.**

friable; noncalcareous; pH about 7.0; gradual, smooth boundary.

C—16 to 60 inches +, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; noncalcareous.

The A horizon ranges from 13 to 18 inches in thickness and from grayish brown to dark grayish brown or dark brown in color. In some places the C horizon is neutral to mildly alkaline to a depth of 60 inches or more, and in some it has a moderate to high content of lime below a depth of 24 inches.

Dunday soils have a darker colored A horizon than Dwyer and Valentine soils. They have a thinner A horizon and are coarser textured than Vetal soils. They are coarser textured than Anselmo, Ascalon, and Manter soils.

Dunday and Dwyer loamy fine sands, 0 to 3 percent slopes (DdA).—This unit occupies uplands, fans, and foot slopes. It occurs in many parts of the Survey Area. Some areas consist of Dunday loamy fine sand, some of Dwyer loamy fine sand, and some partly of each. The Dunday soil has the profile described as typical for the Dunday series. The profile of the Dwyer soil differs from the one described as typical for the Dwyer series in that the surface layer and the underlying material are loamy fine sand. Included in mapping were small areas of Valentine loamy fine sand and Valentine and Dwyer fine sands.

Runoff is slow. In cultivated areas the hazard of water erosion is slight, but the hazard of wind erosion is very severe.

This unit is suited to range, dryland and irrigated crops, windbreaks, and wildlife habitat, particularly habitat for pheasants, sharp-tailed grouse, rabbits, antelope, and deer. Many areas are used for range. Most of the windbreaks are around farmsteads; a few are along field borders.

Lack of moisture is the major limitation in dryland areas. Tame grasses for hay or pasture are well suited. Winter wheat, oats, rye, and barley are suited if wind erosion can be controlled. If small grains are grown, use wind stripcropping and stubble mulching to control wind erosion and conserve moisture.

The low available water capacity is the major limitation in irrigated areas. Alfalfa, alfalfa-grass mixtures, corn, beans, sugar beets, potatoes (fig. 7), and small grains are suitable crops. Light, frequent applications of irrigation water insure even distribution of water and increase the available water capacity. To control erosion and to maintain soil structure, fertility, and the supply of organic matter, use cover crops, crop residues, grasses and legumes in the rotation, and proper kinds and amounts of fertilizer. (Capability unit IVe–4, dryland; IIIe–4, irrigated; Sandy range site; Sandy windbreak site)

Dunday and Dwyer loamy fine sands, 3 to 10 percent slopes (DdC).—Except for slope, this unit is similar to the Dunday and Dwyer loamy fine sands, 0 to 3 percent slopes. Included in mapping were small areas of Valentine fine sand and Dwyer fine sand. In cultivated or otherwise disturbed areas runoff is slow, the water erosion hazard is slight, and the wind erosion hazard is very severe.

This unit is suited to range, close-growing irrigated crops, wildlife food and cover, and windbreaks. Alfalfa, alfalfa-grass mixtures, and small grains are suitable

Figure 7.—**Potatoes on Dunday and Dwyer loamy fine sands, 0 to 3 percent slopes. This mapping unit is in capability unit IIIe–4, irrigated.**

irrigated crops. Light, frequent irrigation using either contour furrows or sprinklers insures even distribution of water, increases the available water capacity, and helps in controlling water erosion. (Capability unit VIe–4, dryland; IVe–4, irrigated; Sandy range site; Very Sandy windbreak site)

Dunday-Trelona complex, 3 to 35 percent slopes (DeE).—This complex is on uplands in the western, southwestern, and southeastern parts of the Survey Area. The Dunday part makes up 30 to 70 percent of the acreage, and the Trelona part makes up 30 to 70 percent. The unit consists of Dunday loamy fine sand and Trelona fine sandy loam. The profiles of these soils are similar to those described as typical for the respective series. Included in mapping were small areas of Rosebud fine sandy loam, Creighton very fine sandy loam, and Tassel fine sandy loam. Also included were several small sandstone outcrops.

Runoff is slight to rapid. In disturbed areas or areas where the vegetation is destroyed, the hazard of wind erosion is very severe and the hazard of water erosion is slight to very severe. (Dunday part in capability unit VIe–4, dryland; Sandy range site; Very Sandy windbreak site. Trelona part in capability unit VIIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Dunday and Vetal loamy fine sands, 0 to 3 percent slopes (DfA).—This unit occurs on old, high terrace benches east of Le Grange. Some of these areas consist of Dunday loamy fine sand, some of Vetal loamy fine sand, and some partly of each. The Dunday soil has the profile described as typical for the Dunday series. The profile of the Vetal soil differs from that described as typical for the Vetal series in that the uppermost 10 to 14 inches of the surface layer is loamy fine sand. Included in mapping were small areas of Ascalon fine sandy loam, 0 to 6 percent slopes, and Vetal fine sandy loam, 0 to 4 percent slopes.

Runoff is slight. In cultivated areas the hazard of wind erosion is very severe, but the hazard of water erosion is slight.

This unit is suited to dryland crops, range, windbreaks, and wildlife habitat, particularly habitat for pheasants, sharp-tailed grouse, rabbits, and antelope. Native grasses are used for grazing in some areas.

Lack of soil moisture is the major limitation. No water is available for irrigation. Winter wheat is the most suitable crop. Other small grains and grasses are also suitable. Use wind stripcropping and stubble mulching to control wind erosion and conserve moisture. (Capability unit IVe–4, dryland; Sandy range site; Sandy windbreak site)

Dunday and Vetal loamy fine sands, 3 to 10 percent slopes (DfC).—Except for slope, this unit is similar to Dunday and Vetal loamy fine sands, 0 to 3 percent slopes. Included in mapping were small areas of Ascalon

fine sandy loam, 6 to 10 percent slopes, and Vetal fine sandy loam, 0 to 4 percent slopes.

Runoff is slight to medium. In disturbed areas or areas where the vegetation is destroyed, the hazard of wind erosion is very severe and the hazard of water erosion is slight to moderate.

This unit is suited to range, windbreaks, and wildlife habitat. (Capability unit VIe–4, dryland; Sandy range site; Very Sandy windbreak site)

Dune Land

Dune land (Dn) is made up of shifting dunes of medium and fine sand. The relief is a succession of low ridges dissected by swales or pockets. There is no surface drainage. The vegetation is too sparse to prevent blowing. Dune land is not suited to commercial plant production. (Capability unit VIIIe–15, dryland; not assigned to a range site or windbreak site)

Duroc Series

The Duroc series consists of deep, well-drained, nearly level and very gently sloping soils in upland swales and shallow drainageways. These soils developed in local alluvium. They occur as small areas in the central, eastern, and southwestern parts of the Survey Area. The native vegetation consists of blue grama, buffalograss, needle-and-thread, and western wheatgrass.

In a typical profile the surface layer is grayish-brown loam about 28 inches thick. The underlying material is light brownish-gray loam.

Duroc soils are fertile and are easy to work. Permeability is moderate, and the available water capacity is high.

Most of the acreage is used for crops. Crops respond well to management.

Typical profile of Duroc loam, 0 to 1 percent slopes, in an area of native range near the northeast corner, SW¼NE¼SW¼ sec. 12, T. 22 N., R. 61 W.:

A11—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong, very fine, granular structure; soft, very friable; noncalcareous; pH 7.2; clear, smooth boundary.

A12—6 to 20 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak to moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard, very friable; noncalcareous; pH 7.4; clear, smooth boundary.

A13—20 to 28 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; slightly hard, very friable; calcareous; pH 8.0; gradual, smooth boundary.

Cca—28 to 60 inches +, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; weak ca horizon contains visible calcium carbonate as concretions and thin seams and streaks; calcareous; pH 8.3.

The A horizon is 20 to 30 inches thick and ranges from grayish brown to dark grayish brown or dark brown in color.

In contrast with Goshen soils and Keith soils, Duroc soils lack a B2t horizon. They have a thicker A horizon than either Ulysses soils or Keith soils.

Duroc loam, 0 to 1 percent slopes (DuA).—This soil has the profile described as typical for the Duroc series. Included in mapping were small areas of Goshen-Kuma loams, 0 to 2 percent slopes; Ulysses loam, 0 to 1 percent slopes; and Keith loam, 0 to 1 percent slopes.

Runoff is slow. In cultivated areas, the hazard of wind erosion is moderate and the hazard of water erosion is slight.

This is one of the best soils for dryland crops in the Survey Area. It is also well suited to irrigated crops, range, windbreaks, and wildlife habitat, particularly habitat for pheasants, sharp-tailed grouse, rabbits, and antelope.

This soil occurs as such small areas that its use and management are largely determined by use and management of the adjacent soils. Winter wheat, oats, rye, alfalfa, corn, and grain sorghum are suitable dryland crops. Practices that conserve moisture and control wind erosion are needed.

If irrigated, this soil has few limitations. Alfalfa, corn, beans, sugar beets, potatoes, and small grains are suitable crops. Use crop residues, manure, and the proper kinds and amounts of commercial fertilizer to control wind erosion and to maintain fertility, soil structure, and the supply of organic matter. (Capability unit IIc–46, dryland; I–1, irrigated; Loamy Overflow range site; Silty to Clayey windbreak site)

Duroc loam, 1 to 3 percent slopes (DuB).—Except for slope, this soil is similar to Duroc loam, 0 to 1 percent slopes. Included in mapping were small areas of Goshen loam, Ulysses loam, and Mitchell silt loam.

Runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

This soil is suitable for dryland and irrigated crops, range, windbreaks, and wildlife food and cover.

Because the areas are so small, the use and management of this soil is largely determined by that of adjacent soils. Small grains, alfalfa, corn, and grain sorghum are suitable dryland crops. Wind stripcropping and stubble mulching help in controlling wind erosion and conserving moisture.

If irrigated, this soil is suited to all crops commonly grown in the Area. Irrigation runs of moderate length are needed for control of erosion and for even water distribution. (Capability unit IIIe–2, dryland; IIe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Dwyer Series

The Dwyer series consists of deep, excessively drained, nearly level to steep soils on uplands and nearly level to moderately steep soils on fans and foot slopes. The soils on uplands developed in wind-laid sands, and those on fans and foot slopes in water-laid sands. These soils occur in most parts of the Survey Area. The native vegetation consists of prairie sandreed, needle-and-thread, and blue grama.

In a typical profile the surface layer is light brown-

ish-gray fine sand about 6 inches thick. The underlying material is very pale brown fine sand.

Permeability is rapid. The available water capacity is low. Fertility is low.

Dwyer soils are well suited to range. Many areas are still in native vegetation and are grazed. Some areas are used for dryland and irrigated crops.

Typical profile of Dwyer fine sand (6 percent slopes) in an area of native range about 200 feet south and 100 feet west of the NE. corner, SE¼NE¼ sec. 26, T. 22 N., R. 61 W.:

A1—0 to 6 inches, light brownish-gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; calcareous; pH about 8.0; gradual, smooth boundary.

C—6 to 60 inches, very pale brown (10YR 7/3) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; calcareous.

The A1 horizon ranges from light brownish gray to pale brown in color and from fine sand to loamy fine sand in texture. The C horizon ranges from light brownish gray to very pale brown in color and from fine sand to loamy fine sand in texture.

The loamy fine sands are more coherent than the fine sands. Dwyer soils differ from Valentine soils in having lime at a depth of less that 30 inches. They have a lighter colored and thinner A horizon than Dunday soils. They have a lighter colored A horizon than Anselmo and Manter soils and are coarser textured.

Dwyer loamy fine sand, 0 to 3 percent slopes (DwA).—This soil is on uplands in the central and eastern parts of the Survey Area. The surface layer and subsoil are loamy fine sand. Otherwise, the profile is similar to that described as typical for the Dwyer series. Included in mapping were small areas of Dunday loamy fine sand.

Runoff is slow. In cultivated areas the hazard of wind erosion is very severe, but the hazard of water erosion is slight.

This soil is suitable for dryland and irrigated crops, range, windbreaks, and wildlife habitat, particularly habitat for pheasants, sharp-tailed grouse, rabbits, antelope, and deer. A large acreage in native grasses is used for grazing.

Tame grasses, winter wheat, oats, barley, and rye are suitable dryland crops. Lack of moisture is the principal limitation. Use alternate strips of crops and stubble mulch to control wind erosion and conserve moisture if small grains are grown.

If irrigated, this soil is well suited to small grains and hay crops. Corn, sugar beets, beans, and potatoes are suitable if wind erosion is controlled. The low available water capacity is the major limitation. Light, frequent irrigations, cover crops, crop residues, and the proper kinds and amounts of fertilizer help in controlling erosion and in maintaining fertility, soil structure, and the supply of organic matter. (Capability unit IVe–4, dryland; IIIe–4, irrigated; Sandy range site; Sandy windbreak site)

Dwyer loamy fine sand, 3 to 10 percent slopes (DwC).—Except for slope, this soil is similar to Dwyer loamy fine sand, 0 to 3 percent slopes. Included in mapping were small areas of Valentine and Dwyer fine sands, rolling, and a small acreage of moderately steep Dwyer loamy fine sand.

In cultivated or otherwise disturbed areas the hazard of wind erosion is very severe, runoff is slow, and the hazard of water erosion is slight to moderate.

This soil is suitable for range, close-growing irrigated crops, and wildlife habitat. It can be used for windbreaks. The low available water capacity and the slope are the principal limitations in irrigated areas. Wheat, oats, barley, rye, alfalfa, and alfalfa-grass mixtures are suitable crops. Contour ditches and light, frequent irrigations help in controlling water erosion and insure even distribution of water. (Capability unit VIe–4, dryland; IVe–4, irrigated; Sandy range site; Very Sandy windbreak site)

Dwyer and Mitchell soils, 10 to 15 percent slopes (DyD).—This unit is on foot slopes in the southern and western parts of the Survey Area. Some of these areas consist of Dwyer loamy fine sand, some of Mitchell silt loam, and some partly of each. The profile of the Dwyer soil is similar to that described as typical for the Dwyer series except that the surface layer and the underlying material are loamy fine sand. The Mitchell soil has a profile similar to that described for the Mitchell series. Included in mapping were small areas of Bordeaux fine sandy loam and Epping silt loam.

In disturbed areas the hazard of wind erosion is very severe, runoff is medium to rapid, and the hazard of water erosion is severe.

These soils are suited to range and wildlife habitat, particularly habitat for sharp-tailed grouse, rabbits, antelope, and deer. They can be used for windbreaks. Almost all the acreage is in range. (Dwyer part in capability unit VIe–4, dryland; Sandy range site; Very Sandy windbreak site. Mitchell part in capability unit VIe–3, dryland; Loamy range site; Silty to Clayey windbreak site)

Epping Series

The Epping series consists of shallow, well-drained, nearly level to moderately steep soils on uplands. These soils occur mainly in the north-central, west-central, and southeastern parts of the Survey Area. They developed in material that weathered in place from soft siltstone. The native vegetation consists of blue grama, threadleaf sedge, and needle-and-thread.

In a typical profile the surface layer is light brownish-gray silt loam, has a high content of lime, and is about 6 inches thick. The underlying material is pale-brown silt loam, has a high content of lime, and is about 3 inches thick. Below this is soft siltstone.

Permeability is moderate. The available water capacity is low.

Epping soils are suited to range. They are not generally suited to cultivation because of shallowness. The areas that are cultivated are generally small and occur in fields with deeper soils.

Typical profile of Epping silt loam, 6 to 10 percent slopes, in an area of native range, 15 feet east and 25

feet north of south quarter corner of sec. 15, T. 24 N., R. 62 W.:

A1—0 to 2 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure breaking to moderate, fine, granular; soft, friable, strongly calcareous; pH about 8.2; clear, smooth boundary.

AC—2 to 6 inches, light brownish-gray (10YR 6/2) silt loam, brown (10YR 5/3) moist; very weak, medium, subangular blocky structure breaking to weak, medium, granular; hard, friable; common fine siltstone chips; strongly calcareous; pH about 8.2; clear, smooth boundary.

C—6 to 9 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; hard, friable; common, fine siltstone chips; strongly calcareous; pH about 8.4; clear, smooth boundary.

R—9 inches +, soft, calcareous siltstone (Brule Formation).

The A1 and AC horizons range from 3 to 10 inches in thickness and from light brownish gray to grayish brown in color. The C horizon ranges from pale brown to light brownish gray or light gray in color. Soft bedrock occurs at a depth of 5 to 18 inches.

Epping soils are shallower than Keota and Mitchell soils. They are coarser textured than Orella soils.

Epping silt loam, 0 to 6 percent slopes (EpB).—This soil has the profile described as typical for the Epping series. Included in mapping were small areas of Keota silt loam, 3 to 6 percent slopes, and Mitchell silt loam, 3 to 6 percent slopes.

In cultivated or otherwise disturbed areas, runoff is medium and the hazard of water and wind erosion is severe.

This soil is suitable for range, close-growing irrigated crops, and wildlife habitat, particularly habitat for sharp-tailed grouse, rabbits, antelope, and deer.

Shallowness and a low available water capacity are the major limitations in irrigated areas. Small grains and grasses can be grown. Light, frequent irrigations, contour ditches, crop residues, and proper kinds and amounts of fertilizer maintain fertility and soil structure and help in controlling erosion. (Capability unit VIe–14, dryland; IVe–14, irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Epping silt loam, 6 to 10 percent slopes (EpC).—Except for slope, this soil is similar to the Epping silt loam, 0 to 6 percent slopes. Included in mapping were small areas of Keota silt loam and Mitchell silt loam.

Runoff is medium. In disturbed areas the hazard of wind and water erosion is severe.

This soil is suited to range, wildlife food and cover, and irrigated hay and pasture. It can be tilled enough to establish a grass cover or to reseed rangeland. Controlled flooding or sprinklers insure even distribution of water and help in controlling water erosion in irrigated areas. (Capability unit VIe–14, dryland; VIe–14, irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Epping silt loam, 10 to 15 percent slopes (EpD).—Except for slope, this soil is similar to Epping silt loam, 0 to 6 percent slopes. Included in mapping were small areas of Keota silt loam and small outcrops of soft siltstone. In disturbed areas or in areas where the vegetation is destroyed, runoff is rapid and the hazard of water and wind erosion is severe.

This soil is suited to range, wildlife habitat, and irrigated hay or pasture. Reseeding range is not practical. Control of water erosion and even distribution of water are factors to be considered in irrigated areas. (Capability unit VIIe–14, dryland; VIe–14, irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Glenberg Series

The Glenberg series consists of deep, well-drained, nearly level to very gently sloping soils on flood plains along Bear Creek, Horse Creek, the North Platte River, and the Laramie River. These soils formed in waterlaid sand. The native vegetation consists of short and intermediate grasses.

In a typical profile the surface layer is grayish-brown to pale-brown fine sandy loam about 7 inches thick. Below this is a transitional layer of pale-brown fine sandy loam about 7 inches thick. The underlying material to a depth of 52 inches is pale-brown fine sandy loam stratified with sand and gravel.

Permeability is moderately rapid, the available water capacity is moderate, and the natural fertility is medium. Cultivation is easy.

Glenberg soils are well suited to range. Many areas are used for irrigated hay, and some for irrigated row crops. Crops respond to good soil management.

Typical profile of Glenberg fine sandy loam, 0 to 3 percent slopes, in native grasses, on the north side of Bear Creek, SW¼SE¼SW¼SW¼ sec. 4, T. 19 N., R. 63 W.:

A11—0 to 2 inches, grayish-brown (10YR 5/2) fine sandy loam; dark brown (10YR 4/3) moist; weak, fine, crumb structure; soft, very friable; calcareous; pH about 8.2; clear, smooth boundary.

A12—2 to 7 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, crumb structure; soft, very friable; calcareous; pH about 8.2; clear, smooth boundary.

AC—7 to 14 inches, pale-brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, crumb structure; slightly hard, very friable; calcareous; pH about 8.4; clear, smooth boundary.

C—14 to 52 inches, pale-brown (10YR 6/3) fine sandy loam, stratified with loamy fine sand, sand, and gravel, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; calcareous; pH about 8.4.

The A and the AC horizons range from grayish brown or pale brown to light brownish gray. In places loose sand and gravel occur below a depth of 40 inches.

Glenberg soils are finer textured throughout than Bankard soils. They are coarser textured than Haverson and McCook soils, and when moist, they have a lighter colored A horizon than McCook soils.

Glenberg fine sandy loam, 0 to 3 percent slopes (GbA).—This soil occurs on flood plains along Bear Creek, Horse Creek, the North Platte River, and the Laramie River. Included in mapping were small areas of Bankard loamy fine sand and of Haverson and McCook loams.

The hazard of wind erosion is severe, and the hazard of water erosion is slight.

This soil is suited to dryland and irrigated crops,

range, and windbreaks. It offers food and cover for wildlife, principally rabbits, pheasants, and deer.

Small grains are suitable dryland crops. The major limitations are the severe hazard of wind erosion and the shortage of moisture. Use wind stripcropping and stubble mulching to conserve moisture and to control wind erosion on dryland.

Alfalfa, corn, beans, potatoes, sugar beets, and small grains are suitable irrigated crops. The principal limitations are the severe hazard of wind erosion and the moderate available water capacity. Manage irrigation water properly, apply the right kinds and amounts of fertilizer, grow cover crops, utilize crop residues, and include grasses and legumes in the rotation. (Capability unit IVe–5, dryland; IIe–5, irrigated; Sandy Lowland range site; Sandy windbreak site)

Goshen Series

The Goshen series consists of deep, well-drained, nearly level soils in upland swales. These soils occur as small areas in the eastern, central, and southwestern parts of the Survey Area. They formed in water-laid loam. The native vegetation consists of blue grama, needle-and-thread, and western wheatgrass.

In a typical profile the surface layer is grayish-brown loam about 10 inches thick. The upper part of the subsoil is grayish-brown heavy loam about 10 inches thick. The middle part is brown light clay loam about 9 inches thick. The lower part, which is about 7 inches thick, is light brownish-gray heavy loam that has a high content of lime. The underlying material is light-gray loam that has a high content of lime.

Permeability is moderate, and the available water capacity is high. Cultivation is easy. The soils are naturally fertile.

Most areas of Goshen soils are used for dryland or irrigated crops. A few areas still in native vegetation are used for range. Crops respond well to good management.

In this Survey Area Goshen soils are mapped only as a complex with Kuma soils.

Typical profile of Goshen loam (less than 1 percent slopes) in a cultivated field, 50 feet west of the county road, NE¼SE¼NE¼SE¼ sec. 16, T. 21 N., R. 60 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong, very fine, granular structure; slightly hard, very friable; noncalcareous; pH 7.2; clear, smooth boundary.

A3—6 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, subangular blocky structure breaking to strong, fine, granular; slightly hard, very friable; noncalcareous; pH 7.4; clear, smooth boundary.

B21t—10 to 20 inches, grayish-brown (10YR 5/2) heavy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, very friable; many thin, patchy clay films on horizontal and vertical faces of peds; noncalcareous; pH 7.4; clear, smooth boundary.

B22t—20 to 29 inches, brown (10YR 5/3) light clay loam, dark brown (10YR 3/3) moist; weak, medium, prismatic structure breaking to strong, medium, subangular blocky; hard, very friable; many thin, patchy clay films on horizontal and vertical faces of peds; noncalcareous; pH 7.6; clear, smooth boundary.

B3ca—29 to 36 inches, light brownish-gray (10YR 6/2) heavy loam, dark grayish brown (10YR 4/2) moist; weak to moderate, medium, subangular blocky structure; hard, very friable; few thin, patchy clay films on horizontal and vertical faces of peds; this is a very weak ca horizon with some visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.0; gradual, smooth boundary.

Cca—36 to 60 inches, light-gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; massive; hard, very friable; this is a weak ca horizon with visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.2.

The A horizon ranges from 6 to 13 inches in thickness and from grayish brown to dark grayish brown or dark brown in color. The B21t horizon is grayish brown to dark grayish brown; the B22t horizon is brown to dark brown.

Goshen soils have a B2t horizon, which is lacking in Duroc soils. They have a thicker A horizon than Keith soils, and they have more clay in the B horizon than Ulysses soils. Unlike Kuma soils, Goshen soils lack a buried soil.

Goshen-Kuma loams, 0 to 2 percent slopes (GkA).—This complex occurs in upland swales in the eastern, central, and southwestern parts of the Survey Area. The Goshen part makes up 60 to 80 percent of the acreage, and the Kuma part makes up 20 to 40 percent. The soils have the profiles described as typical of their respective series. Included in mapping were small areas of Duroc loam, 0 to 1 percent slopes; Keith loam, 0 to 1 percent slopes; Rosebud and Norka loams, 0 to 1 percent slopes; and Norka-Weld loams, 0 to 6 percent slopes.

The hazard of water erosion is slight, and the hazard of wind erosion is moderate. Surface runoff is slow.

This complex is well suited to dryland crops, but it occurs only as small areas. It is well suited to irrigated crops, range, and windbreaks. It offers food and cover for wildlife, principally pheasant and rabbits. Habitat can be developed for sharp-tailed grouse, antelope, and deer.

Winter wheat, oats, barley, rye, alfalfa, corn, and grain sorghum are suitable dryland crops. Because the complex occurs as small areas, it is usually farmed along with adjacent soils. Practices to conserve moisture and control wind erosion are needed.

Alfalfa, corn, beans, sugar beets, potatoes, and small grains are suitable irrigated crops. Use cover crops, manure, crop residue, the proper kinds and amounts of fertilizer, and good management of irrigation water to maintain fertility and preserve soil structure. (Capability unit IIc–46, dryland; I–1, irrigated; Loamy Overflow range site; Silty to Clayey windbreak site)

Gullied Land

Gullied land (Gu) consists of gullies that have cut deeply into friable soils. Individual areas may consist of a single large gully or a network of large and small ones. All or nearly all of the original soil material has been destroyed. A few of the gullied areas have stabilized sides and bottoms, and some have partly stabilized sides. Gullying is still active, however, in most

places. Included in mapping were small areas where siltstone and sandstone bedrock are exposed.

Stabilized areas are suitable for some grazing and for development of wildlife habitat. Woody plants can be established in most places, but onsite investigation is needed to determine whether planting is feasible and what species are suitable. (Capability unit VIIe-82, dryland; not assigned to a range site or windbreak site)

Hargreave Series

The Hargreave series consists of moderately deep, well-drained, nearly level to moderately steep soils on tablelands in the western and southwestern parts of the Survey Area. These soils developed in material that weathered in place from soft, noncalcareous sandstone. The native vegetation consists of blue grama, buffalograss, and needle-and-thread.

In a typical profile the surface layer is dark grayish-brown very fine sandy loam or fine sandy loam about 8 inches thick. The uppermost 4 inches of the subsoil is dark-brown sandy clay loam. The middle part is yellowish-brown very fine sandy loam about 7 inches thick. The lower 9 inches is light yellowish-brown very fine sandy loam. The underlying material is pale-brown very fine sandy loam. Soft, noncalcareous sandstone begins at a depth of about 33 inches.

Permeability is moderate, and the available water capacity is moderate. The soils are fertile, and cultivation is easy.

Some areas of Hargreave soils are still in native vegetation and are used for grazing. Others have been plowed and are used for dryland crops. In this Survey Area, Hargreave soils are mapped only with Rosebud soils.

Typical profile of Hargreave very fine sandy loam (4 percent slope) in a cultivated field, 900 feet south and 200 feet east of the NW. corner of SW¼ sec. 36, T. 21 N., R. 64 W.:

Ap1—0 to 2 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; friable; noncalcareous; pH about 6.9; abrupt, smooth boundary.

Ap2—2 to 8 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard, friable; many roots; noncalcareous; pH about 6.9; abrupt, smooth boundary.

B21t—8 to 12 inches, dark-brown (10YR 4/3) sandy clay loam, very dark grayish brown (10YR 3/2) moist; strong, fine to medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable, sticky; thin, continuous clay films; many roots; noncalcareous; pH about 7.0; clear, smooth boundary.

B22t—12 to 19 inches, yellowish-brown (10YR 5/4) very fine sandy loam, dark brown (10YR 4/3) moist; weak, medium to coarse, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable; surfaces of prisms are darker colored than matrix; thin, patchy clay films on vertical faces of peds; noncalcareous; pH about 6.7; gradual, wavy boundary.

B3—19 to 28 inches, light yellowish-brown (10YR 6/4) very fine sandy loam, brown (10YR 5/3) moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; hard, friable; noncalcareous; pH about 6.8; gradual, wavy boundary.

C—28 to 33 inches, pale-brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; weak, medium, subangular blocky structure; hard, friable; noncalcareous; pH about 6.9; abrupt, irregular boundary.

R—33 inches +, soft, noncalcareous sandstone.

The A horizon ranges from very fine sandy loam to fine sandy loam in texture and from dark grayish brown to grayish brown in color. The depth to soft bedrock ranges from 20 to 40 inches.

Hargreave soils differ from Rosebud soils by lacking zones of calcium carbonate accumulation. They are deeper than Trelona soils, and they have a B2t horizon, which is lacking in Trelona soils.

Haverson Series

The Haverson series consists of deep, well-drained, nearly level to very gently sloping soils on flood plains along the North Platte and the Laramie Rivers, and in small places along Horse Creek. These soils formed in water-laid loam. The native vegetation consists of short and tall grasses.

In a typical profile the surface layer is light brownish-gray loam about 7 inches thick. This is underlain by light brownish-gray loam that is stratified with thin lenses of sandy loam and very fine sandy loam.

Permeability is moderate, and the available water capacity is high. The soils are fertile, and cultivation is easy. Crops respond well to good management.

Most areas of these soils are used for irrigated crops. Small areas are used for native range.

A typical profile of Haverson loam (less than 1 percent slope), in an area of native vegetation, 600 feet southwest of the NE. corner of sec. 10, T. 23 N., R. 60 W.:

A1—0 to 7 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate, fine, granular structure; slightly hard, very friable; calcareous; pH about 8.3; clear, smooth boundary.

C—7 to 60 inches +, light brownish-gray (2.5Y 6/2) loam stratified with thin lenses of sandy loam and very fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; calcareous; pH about 8.3.

The A horizon ranges from loam to fine sandy loam in texture, and from light brownish gray to grayish brown in color. The texture of the thin strata in the C horizon ranges from sand to clay loam. Loose sand and gravel occur at depths below 40 inches in place.

Haverson soils have a lighter colored A horizon than McCook soils. They are finer textured throughout than Glenberg and Bankard soils.

Haverson fine sandy loam, 0 to 3 percent slopes (HaA).—This soil occurs on flood plains along the North Platte and the Laramie Rivers and Horse Creek. Except for the texture of the surface layer, this soil has a profile similar to that described as typical of the series. Included in mapping were small areas of Haverson and McCook loams, Glenberg fine sandy loam, and Bankard loamy fine sand.

Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is severe if this soil is cultivated.

This soil is suited to irrigated and dryland crops, range, and farmstead windbreaks. It offers food and cover for wildlife, principally pheasants and rabbits.

Very little of this soil is dryfarmed, but small grains are suitable crops. Alfalfa, corn, and grain sorghum can be grown. The lack of moisture is the major limitation. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion.

All the crops commonly grown in the Area are suitable if irrigated. The moderate available water capacity is the major limitation. Good management of irrigation water, use of cover crops and crop residue, inclusion of grasses and legumes in rotations, and application of the right kinds and amounts of fertilizer are needed. These practices preserve soil structure, maintain fertility, and control wind erosion. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Sandy Lowland range site; Sandy windbreak site)

Haverson loam, gravel substratum variant, 0 to 3 percent slopes (HgA).—This soil occurs on flood plains along the North Platte and Laramie Rivers. Loose sand and gravel occur at depths between 20 and 40 inches, but otherwise the profile is similar to the one described as typical of the series. Included in mapping were small areas of Haverson and McCook loams, and Bankard loamy fine sand.

If this soil is cultivated, the hazard of wind erosion is moderate and the hazard of water erosion is slight.

This soil is suited to irrigated and dryland crops, range, and windbreaks. It offers food and cover for wildlife. Habitat for pheasants, rabbits, and deer can be developed.

Corn, sugar beets, beans, potatoes, small grains, and alfalfa are suitable irrigated crops. Include grasses and legumes in the rotation, utilize crop residues and manure, manage irrigation water properly, and apply the right kinds and amounts of fertilizer.

This soil is not generally used for dryland crops, but small grains, corn, and grain sorghum can be grown. Lack of moisture is the principal limitation. Use alternating strips of crops and stubble mulch to conserve moisture and control wind erosion. (Capability unit IIIs–2, dryland; IIs–2, irrigated; Loamy Lowland range site; Silty to Clayey windbreak site)

Haverson and McCook loams, 0 to 3 percent slopes (HnA).—This unit occurs on flood plains along the North Platte River, the Laramie River, and Horse Creek. Some of these areas consist of Haverson loam, some of McCook loam, and some partly of each. The soils have the profiles described as typical of their respective series. Included in mapping were small areas of the gravel substratum variant of Haverson loam, of Haverson fine sandy loam, and of Glenberg fine sandy loam.

In cultivated areas runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

These soils are suited to irrigated crops, range, and farmstead windbreaks. They offer food and cover for wildlife, principally pheasants and rabbits. Dryland crops are seldom grown.

All the crops commonly grown are suitable if irrigated, and there are few limitations. Use good management practices to maintain fertility, preserve soil structure, control wind erosion, and maintain productivity.

Small grains, alfalfa, corn, and grain sorghum are suitable dryland crops. Lack of moisture is the principal limitation. Use wind stripcropping and stubble mulching to control wind erosion and conserve moisture on dryland. (Capability unit IIIc–2, dryland; I–1, irrigated; Loamy Lowland range site; Silty to Clayey windbreak site)

Hawksprings Series

The Hawksprings series consists of well-drained, nearly level to sloping soils on fans, foot slopes, and stream terraces. These soils occur below high terrace escarpments along the North Platte River and below remnants of terrace rims in the southern part of the Area. They formed in water-laid sand and gravel. The native vegetation consists of needle-and-thread, blue grama, and Indian ricegrass.

In a typical profile the surface layer is grayish-brown sandy loam about 26 inches thick. The next layer is light brownish-gray sandy loam about 6 inches thick. This is underlain by light-gray, loose very gravelly sand.

Permeability is moderately rapid, the available water capacity is moderate to low, and the natural fertility is medium. Cultivation is easy.

Many areas of Hawksprings soils are still in native vegetation and are used for range. Some areas have been plowed and used for irrigated crops. Crops respond to good soil management.

In this Survey Area, Hawksprings soils are mapped only with Chappell soils.

Typical profile of Hawksprings sandy loam (less than 1 percent slopes), in a cultivated field, near the center of SE¼SE¼NW¼ sec. 10, T. 23 N., R. 60 W.:

A11—0 to 8 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure breaking to moderate, fine, granular; slightly hard, very friable; noncalcareous; pH 7.6; gradual, smooth boundary.

A12—8 to 26 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure breaking to weak to moderate, medium, subangular blocky; slightly hard, very friable; noncalcareous; pH 7.6; gradual, smooth boundary.

C1ca—26 to 32 inches, light brownish-gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; massive or very weak, medium, subangular blocky structure; slightly hard, very friable; a weak ca horizon with visible calcium carbonate occurring as concretions and thin seams; calcareous; pH 8.2; clear, smooth boundary.

IIC2ca—32 to 60 inches +, light-gray (10YR 7/2) very gravelly sand, light brownish gray (10YR 6/2) moist; single grain; loose; 60 to 70 percent gravel; some lime coatings on the pebbles throughout the horizon; calcareous; pH 8.2.

The A horizon ranges from sandy loam to fine sandy loam in texture, and from grayish brown to dark grayish brown or dark brown in color. The depth to loose sand and gravel ranges from 20 to 40 inches.

Hawksprings soils have a thicker A horizon than Chappell and Dix soils. They have less gravel in the profile than Dix soils.

Heldt Series

The Heldt series consists of deep, well-drained, nearly level soils on fans and valley side slopes along Cherry Creek and Katzer Drain. These soils formed in water-laid clay. The native vegetation consists of western wheatgrass and blue grama.

In a typical profile the surface layer is light brownish-gray silty clay about 6 inches thick. The subsoil is light brownish-gray silty clay about 34 inches thick. The underlying material is light-gray silty clay that grades to heavy silty clay loam.

Permeability is moderately slow, the available water capacity is high, and the natural fertility is medium. These soils are difficult to work but respond well to good soil management.

Heldt soils are well suited to range and irrigated hay and pasture. Many areas have been plowed and are used for irrigated crops.

Typical profile of Heldt silty clay, 0 to 3 percent slopes, in a field of irrigated hay, 517 feet east and 187 feet north of the east abutment of the bridge over Cherry Creek, SW¼SE¼SW¼ sec. 25, T. 24 N., R. 62 W.:

A1—0 to 6 inches, light brownish-gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; strong, very fine, granular structure; soft, very friable; calcareous; pH 8.2; clear, smooth boundary.

B2—6 to 40 inches, light brownish-gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; moderate, coarse, prismatic structure breaking to moderate, coarse, angular blocky; extremely hard, very firm; a few patchy clay films principally on the vertical faces of peds; calcareous; pH 8.5; gradual, wavy boundary.

C1ca—40 to 50 inches, light-gray (2.5Y 7/2) silty clay, grayish brown (2.5Y 5/2) moist; massive or very weak, medium, subangular blocky structure; extremely hard, firm; few, fine, faint, reddish-brown (5YR 5/4) mottles; this is a weak ca horizon with some visible calcium carbonate occurring as concretions and thin seams and streaks; a small amount of calcium sulfate in the form of small crystals; calcareous; pH 8.3; gradual, smooth boundary.

C2ca—50 to 60 inches, light-gray (2.5Y 7/2) heavy silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, very friable; a very weak ca horizon with a small amount of calcium carbonate occurring as concretions and a small amount of calcium sulfate occurring as crystals; calcareous; pH 8.2.

The A horizon ranges from silty clay loam to clay in texture and from light brownish gray to grayish brown in color. The B horizon ranges from light brownish gray to light gray in color and from silty clay to clay in texture.

Heldt soils are finer textured than Kim soils. They are deeper and less alkaline than Orella soils.

Heldt clay, 0 to 3 percent slopes (HtA).—This soil occurs on fans or valley side slopes along Cherry Creek and Katzer Drain. Included in mapping were small areas of Kim clay loam, alkali, 0 to 1 percent slopes, and of Alkali and saline land.

If this soil is cultivated, runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

This soil is suited to irrigated and dryland crops, range, and windbreaks. It offers food and cover for wildlife. Pheasants and rabbits are numerous, and waterfowl find suitable habitat.

Alfalfa, corn, sugar beets, beans, and small grains are suitable irrigated crops. The major problems in managing irrigated land are maintenance of tilth and fertility. Include grasses and legumes in the rotation, utilize crop residue and manure, apply the right kinds and amounts of fertilizer, and manage irrigation water properly.

Tame grasses are the most suitable dryland crop, but small grains can be grown also. Lack of moisture is the major limitation, and maintenance of tilth is the principal problem in managing dryland. If small grains are grown, use wind stripcropping and stubble mulching to maintain tilth, conserve moisture, and control wind erosion. (Capability unit IVs–1, dryland; IIIs–1, irrigated; Clayey range site; Silty to Clayey windbreak site)

Keith Series

The Keith series consists of deep, well-drained, nearly level to gently sloping soils on uplands in the central and eastern parts of the Survey Area. These soils formed in wind-laid silt. The native vegetation consists of needle-and-thread, blue grama, and buffalograss.

In a typical profile the surface layer is grayish-brown loam about 5 inches thick. The upper part of the subsoil is grayish-brown and pale-brown loam or heavy loam about 17 inches thick. The lower part is light-gray loam about 10 inches thick. The underlying material is light-gray to pale-brown loam that has a high content of lime.

Permeability is moderate, the available water capacity is high, and natural fertility is high. Cultivation is easy.

Most areas of Keith soils have been plowed and are used for dryland and irrigated crops. Crops respond to good management.

Typical profile of Keith loam, 0 to 1 percent slopes, in an area of native vegetation, 87 feet south and 30 feet east of the NW. corner of NE¼NE¼NW¼ sec. 28, T. 22 N., R. 60 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong, fine, granular structure; soft, very friable; noncalcareous; pH 7.4; clear, smooth boundary.

B1—5 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure breaking to moderate, subangular blocky; slightly hard, very friable; few thin, patchy clay films principally on vertical faces of peds; noncalcareous; pH 7.6; clear, smooth boundary.

B21t—10 to 18 inches, grayish-brown (10YR 5/2) heavy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure breaking to moderate to strong, medium, subangular blocky; hard, very friable; many, thin, patchy clay films on peds; noncalcareous; pH 7.8; clear, smooth boundary.

B22t—18 to 22 inches, pale-brown (10YR 6/3) heavy loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure breaking to moderate

to strong, medium, subangular blocky; hard, very friable; many, thin, patchy clay films on peds; noncalcareous; pH 7.8; clear, smooth boundary.

B3ca—22 to 32 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; moderate, medium, subangular blocky structure; hard, very friable; few, thin, patchy clay films on peds; visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.4; gradual, wavy boundary.

C1ca—32 to 50 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; massive; hard, very friable; visible calcium carbonate occurring as concretions and thin seams and streaks and in finely divided forms; calcareous; pH 8.4; gradual, wavy boundary.

C2ca—50 to 60 inches +, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; hard, very friable; visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.4.

The A horizon ranges from 3 to 6 inches in thickness and from grayish brown to dark grayish brown or dark brown in color. The B1 and B2t horizons range from dark grayish brown to pale brown in color and from loam to light clay loam in texture. Soft sandstone or siltstone occurs below a depth of 48 inches in some places.

Keith soils have thicker A and B horizons than Norka soils. They have more clay in the B horizon than Ulysses soils. They have a thinner A horizon than Goshen and Duroc soils. They differ from Duroc soils in having a B2t horizon.

Keith loam, 0 to 1 percent slopes (KeA).—This soil has the profile described as typical of the series. Included in mapping were small areas of Norka loam, Ulysses loam, and Goshen loam.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion is moderate.

This soil is suited to irrigated and dryland crops, range, and farmstead windbreaks. It offers food and cover for wildlife, principally pheasants. Rabbits are common.

Sugar beets, alfalfa corn, beans, potatoes, and small grains are suitable irrigated crops. There are few limitations on irrigated soils. To maintain fertility and tilth, manage irrigation water properly, utilize crop residue and manure, and apply the right kinds and amounts of fertilizer.

Winter wheat is the most suitable dryland crop. Oats, barley, and rye are also suited. Alfalfa, corn, and grain sorghum can be grown, but they are not well suited because of the shortage of moisture. A system of summer fallow and cropping in alternate strips conserves moisture. (Capability unit IIIc–2, dryland; I–1, irrigated; Loamy range site; Silty to Clayey windbreak site)

Keith loam, 1 to 3 percent slopes (KeB).—Except for slope, this soil has the profile described as typical for the series. Included in mapping were small areas of Norka loam, Ulysses loam, and Mitchell silt loam.

In cultivated areas runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is moderate.

This soil is suited to irrigated and dryland crops, range, and wildlife habitat.

If irrigated, this soil is suited to all crops commonly grown in the Area. Irrigation runs of moderate length are needed for control of erosion and even distribution of water.

Winter wheat, barley, oats, and rye are well-suited dryland crops. Wind stripcropping and stubble mulching conserve moisture and control wind erosion in areas used for dryland crops. (Capability unit IIIe–2, dryland; IIe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Keith loam, 3 to 6 percent slopes (KeC).—This soil is similar to the soil described as typical for the series, except that the surface layer is 3 or 4 inches thick and the depth to lime is 16 to 20 inches. In some places, deep plowing has mixed the surface layer with the subsoil. Included in mapping were small areas of Norka loam, Ulysses loam, and Mitchell silt loam. Also included was about 80 acres of Keith loam, 6 to 10 percent slopes.

Runoff is medium. Water erosion is a moderate hazard in cultivated areas. Fields that have no growing crop or crop residue on the surface are subject to wind erosion.

This soil is suited to dryland and irrigated crops, range, windbreaks, and wildlife habitat. Wind stripcropping and stubble mulching conserve moisture and control wind erosion in areas used for dryland crops. Short irrigation runs on the contour are needed for control of erosion. Bench leveling or sprinkler irrigation is helpful. (Capability unit IIIe–2, dryland; IIIe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Keota Series

The Keota series consists of moderately deep, well-drained, nearly level to moderately steep soils that occur mainly in the north-central, west-central, and southeastern parts of the Survey Area. On uplands these soils formed in material that weathered in place from soft siltstone. On fans and foot slopes they formed in water-laid silt. The native vegetation is blue grama and threadleaf sedge.

In a typical profile the surface layer is light brownish-gray or grayish-brown loam about 6 inches thick. It has a high content of lime. The underlying material is pale-brown loam that has a high content of lime. Soft siltstone occurs at a depth of 32 inches. Many small siltstone chips occur on the surface and in the profile.

Permeability is moderate, the available water capacity is moderate, and natural fertility is low. Cultivation is easy.

Keota soils are well suited to range, and many areas are in range. Some areas have been plowed and are used for dryland and irrigated crops. Crops respond to good management.

The Keota silt loams and Keota loams are both mapped as Keota silt loam in the Survey Area.

Typical profile of Keota loam (3 percent slope) in a cultivated field, 370 feet south and 45 feet west of the NE. corner of sec. 8, T. 23 N., R. 61 W.:

Ap—0 to 2½ inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine,

granular structure; hard, friable; many fine roots; calcareous; pH 8.2; abrupt, smooth boundary.

AC—2½ to 5½ inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure breaking to weak, fine granular; friable; many fine roots; calcareous; pH 8.1; clear, smooth boundary.

C1—5½ to 11 inches, pale-brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure breaking to weak, fine, granular; hard, friable; many fine roots, strongly calcareous; pH 8.1; clear, wavy boundary.

C2—11 to 17 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, very fine, granular structure; friable; strongly calcareous; pH 8.3; clear, wavy boundary.

C3—17 to 22 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; very friable; strongly calcareous; pH 8.2; gradual, wavy boundary.

C4—22 to 32 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; friable; strongly calcareous; pH 8.3; abrupt, irregular boundary.

R—32 inches +, soft, calcareous siltstone.

The Ap and AC horizons range from loam to silt loam in texture, from 4 to 8 inches in thickness, and from grayish brown to light brownish gray in color. The C horizon ranges from loam to silt loam in texture. The depth to soft siltstone is 20 to 40 inches.

Keota soils differ from Mitchell soils in having soft bedrock at a depth of 20 to 40 inches. They are deeper over bedrock than Epping soils.

Keota silt loam, 0 to 3 percent slopes (KoA).—This soil occurs on uplands and fans. It has the profile described as typical for the series. Included in mapping were small areas of Mitchell silt loam, Epping silt loam, and Alkali and saline land.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion severe.

This soil is suited to irrigated and dryland crops, farmstead windbreaks, and range. It offers food and cover for wildlife, principally pheasants and rabbits. Habitat for sharp-tailed grouse, antelope, and deer can be developed.

Corn, sugar beets, beans, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. The major problems are maintenance of fertility, structure, and organic-matter content, and control of erosion. To meet these problems, manage irrigation water properly, include grasses and legumes in the rotation, utilize crop residues and manure, and apply the right kinds and amounts of fertilizer. Special fertilizer may be needed for crops that are sensitive to the high content of lime.

Tame grasses, winter wheat, oats, rye, and barley are suitable dryland crops. Lack of moisture is the major limitation. Wind stripcropping and stubble mulching help in conserving moisture and controlling erosion. (Capability unit IVe–3, dryland; IIe–3, irrigated; Loamy range site; Silty to Clayey windbreak site)

Keota silt loam, 3 to 6 percent slopes (KoB).—Except for slope, this soil is similar to Keota silt loam, 0 to 3 percent slopes. Included in mapping were small areas of Mitchell silt loam and Epping silt loam.

In cultivated areas runoff is medium, the hazard of water erosion is moderate, and the hazard of wind erosion severe.

This soil is suited to range, irrigated crops, windbreaks, and wildlife food and cover. It can be used for dryland crops.

If irrigated, this soil is suited to the crops commonly grown in the Area. Use runs of moderate lengths and contour furrows to insure even distribution of water and help control water erosion.

Tame grasses are the most suitable dryland crop, but winter wheat, oats, barley, and rye can be grown. If small grains are grown, use a combination of terraces, contour strips, and stubble mulch to conserve moisture and control erosion. (Capability unit IVe–3, dryland; IIIe–3, irrigated; Loamy range site; Silty to Clayey windbreak site)

Keota-Epping silt loams, 6 to 15 percent slopes (KpD).—This complex occurs on uplands. The Keota part makes up 40 to 60 percent of the acreage, and the Epping part makes up 40 to 60 percent. The soils have the profiles described as typical of their respective series. Included in mapping were small areas of Mitchell silt loam.

If this complex is plowed or otherwise disturbed, runoff is rapid and the hazard of water and wind erosion is severe.

This complex is suited to range, irrigated hay and pasture, and wildlife habitat. The Keota soil is also suited to windbreaks. Most of the acreage is in range. Habitat for pheasant, sharp-tailed grouse, rabbit, antelope, and deer can be developed.

On irrigated hay and pasture, use contour ditches or sprinklers to insure even distribution of water and to help control erosion. (Keota part in capability unit VIe–3, dryland and irrigated; Loamy range site; Silty to Clayey windbreak site. Epping part in capability unit VIe–14, dryland and irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Kim Series

The Kim series consists of deep, well-drained, nearly level to sloping soils on fans and foot slopes in the western, central, and eastern parts of the Survey Area. These soils formed in water-laid silt and clay. The native vegetation consists of western wheatgrass, blue grama, and buffalograss.

In a typical profile the surface layer is light-gray clay loam about 8 inches thick. It is underlain by light brownish-gray clay loam about 30 inches thick. Below this is light yellowish-brown to pale-yellow clay loam that is strongly calcareous.

Permeability is moderately slow, the available water capacity is high, and natural fertility is low to medium. These soils are difficult to work.

Kim soils are well suited to range, and many areas are used for this purpose. Some areas are used for dryland and irrigated crops. Crops respond to good management.

Typical profile of Kim clay loam, alkali, 3 to 10 percent slopes, in a cultivated field, about 1,025 feet

south and 125 feet east of the NW. corner of sec. 3, T. 23 N., R. 62 W.:

Ap—0 to 8 inches, light-gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate, medium, granular structure; hard, friable; many fine roots; stongly calcareous; pH 8.4; clear, smooth boundary.

C1—8 to 20 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; hard, friable; some fine roots and old, filled root channels that are darker in color; strongly calcareous; pH 8.6; gradual, smooth boundary.

C2—20 to 38 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak, medium, granular structure; hard; strongly calcareous; pH 8.6; gradual, smooth boundary.

C3—38 to 49 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/4) moist; weak, fine, granular structure; hard, friable; strongly calcareous; pH 9.0; gradual, smooth boundary.

C4—49 to 66 inches +, pale-yellow (2.5Y 7/3) clay loam, light yellowish brown (2.5Y 6/4) moist; weak, medium, granular structure; hard, friable; strongly calcareous; pH 9.0.

The A horizon ranges in color from light gray to grayish brown. Reaction in the C1 and C2 horizons is normally strongly alkaline. In some Kim soils reaction is moderately alkaline.

In contrast with Heldt soils, Kim soils are coarser textured and lack a B2 horizon. They are deeper and coarser textured than Orella soils.

Kim clay loam, alkali, 0 to 1 percent slopes (KyA).—This soil occurs on fans in the western, central, and eastern parts of the Survey Area. Except for slope, it is similar to the soil described as typical for the series. Included in mapping were small areas of Heldt clay, Orella clay, Mitchell silt loam, and Alkali and saline land.

In cultivated areas runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion moderate.

This soil is suited to range, irrigated and dryland crops, windbreaks, and wildlife habitat. Habitat can be developed for pheasants, sharp-tailed grouse, rabbits, antelope, and deer.

Corn, alfalfa, alfalfa-grass mixtures, small grains, beans, and sugar beets are suitable irrigated crops. The major problems in irrigated areas are maintaining tilth and increasing the rate of permeability. Include grasses and legumes in the rotation, utilize crop residues and manure, manage irrigation water properly, and apply the right kinds and amounts of fertilizer.

Tame grasses and small grains are suitable dryland crops. If small grains are grown, use alternate strips of crops and stubble mulch to conserve moisture and control wind erosion. Native grasses are used for grazing in some places. Prevent overgrazing and trampling when the soil is wet. (Capability unit IVs–1, dryland; IIIs–1, irrigated; Clayey range site; Silty to Clayey windbreak site)

Kim clay loam, alkali, 1 to 3 percent slopes (KyB).—The profile of this soil is similar to the one described as typical of the series. Included in mapping were small areas of Mitchell silt loam, Orella clay, Heldt clay, and Alkali and saline land.

Runoff is slow to medium. In cultivated areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion moderate.

This soil is suited to range, irrigated crops, and windbreaks. It can be used for dryland crops. Wildlife habitat can be developed.

Alfalfa, alfalfa-grass mixtures, small grains, corn, beans, and sugar beets are suitable irrigated crops. Irrigation runs of moderate lengths insure even distribution of water and help control water erosion.

Tame grasses are well suited, but small grains can be grown. In dryland areas, use wind stripcropping and stubble mulching to conserve moisture and control erosion. (Capability unit IVe–1, dryland; IIIe–1, irrigated; Clayey range site; Silty to Clayey windbreak site)

Kim clay loam, alkali, 3 to 10 percent slopes (KyC).—This soil has the profile described as typical of the series. Included in mapping were a few acres of moderately steep Kim clay loam, alkali, and small areas of Mitchell silt loam.

Runoff is medium to rapid. In cultivated areas, the hazard of water erosion is moderate to severe and the hazard of wind erosion moderate.

This soil is suited to range, windbreaks, wildlife food and cover, and close-growing irrigated crops. It can also be used for dryland crops.

Small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. Contour ditches and proper irrigation practices insure even distribution of water and help control erosion.

Tame grasses are suitable dryland crops. If small grains are grown, a combination of terracing, contour stripcropping, and stubble mulching is needed to conserve moisture and control erosion. (Capability unit IVe–1, dryland; IVe–1, irrigated; Clayey range site; Silty to Clayey windbreak site)

Kuma Series

The Kuma series consists of deep, well-drained, nearly level soils on uplands in the eastern, central, and southwestern parts of the Survey Area. These soils are in swales. They formed in water-laid loam. The native vegetation consists of blue grama, needle-and-thread, and western wheatgrass.

In a typical profile the surface layer is dark grayish-brown loam about 7 inches thick. The upper part of the subsoil, about 20 inches thick, is dark-brown to dark grayish-brown loam that grades to clay loam. The lower part of the subsoil, about 15 inches thick, is dark-gray clay loam and dark grayish-brown heavy loam. The underlying material is light olive-brown sandy clay loam.

Permeability is moderate, the available water capacity is high, and natural fertility is high. Cultivation is easy.

Most areas of Kuma soils are used for dryland or irrigated crops, but a few are in range. Crops respond well to good management.

The Kuma soils in this Survey Area are mapped only as a complex with Goshen soils.

Typical profile of Kuma loam (1 percent slopes) in native range, 950 feet east and 1,000 feet south of the NW. corner of sec. 15, T. 21 N., R. 65 W.:

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; soft, very friable; noncalcareous; pH about 7.0; abrupt, smooth boundary.

A12—3 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; very weak, medium, subangular blocky structure breaking to weak, fine, granular; slightly hard, friable; a few fine pores; noncalcareous; pH about 7.2; clear, smooth boundary.

B1—7 to 14 inches, dark-brown (10YR 4/3 dry to 10YR 3/3 moist) loam; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable; thin, patchy clay films on peds; a few fine pores; noncalcareous; pH about 7.4; clear, smooth boundary.

B21t—14 to 18 inches, dark-brown (10YR 4/3 dry to 10YR 3/3 moist) clay loam; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable, sticky; thin, almost continuous clay films on peds; a few fine pores; noncalcareous; pH about 7.4; clear, smooth boundary.

B22t—18 to 27 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, prismatic structure breaking to strong, fine, subangular blocky; very hard, firm, sticky and slightly plastic; thin, continuous clay films on peds; a few fine pores; noncalcareous; pH about 7.4; abrupt, smooth boundary.

B23tb—27 to 30 inches, dark-gray (10YR 4/1) light clay loam, very dark gray (10YR 3/1) moist; weak, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard, friable, sticky and slightly plastic; thin, continuous clay films on vertical faces of peds and thin, patchy clay films on horizontal faces; a few fine pores; noncalcareous; pH about 7.4; clear, smooth boundary.

B24tb—30 to 36 inches, dark-gray (10YR 4/1) light clay-loam, very dark gray (10YR 3/1) moist; moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard, friable, sticky; thin, continuous clay films on vertical faces of peds and thin, patchy clay films on horizontal faces; common, fine pores; noncalcareous; pH about 7.4; gradual, smooth boundary.

B3b—36 to 42 inches, dark grayish-brown (2.5Y 4/2) heavy loam, very dark gray (10YR 3/1) moist; weak, fine, prismatic structure breaking to weak, fine, subangular blocky; hard, friable, sticky; thin, patchy clay films on vertical faces of peds; common, fine pores; noncalcareous; pH about 7.4; abrupt, wavy boundary.

Cb—42 to 48 inches, light olive-brown (2.5Y 5/4) sandy loam, olive brown (2.5Y 4/4) moist; weak, [illegible], subangular blocky structure; hard, friable, sti[illegible], noncalcareous; pH about 7.4.

The color of the A horizon ranges from dark grayish brown or dark brown to grayish brown, and the texture from loam to very fine sandy loam. The Cb horizon ranges in texture from sandy clay loam to very fine sandy loam. Reaction is mildly alkaline to moderately alkaline.

Kuma soils differ from Goshen soils in having a buried soil in the profile. They differ from Duroc soils in having a B2t horizon.

Manter Series

The Manter series consists of deep, well-drained, nearly level to sloping soils on uplands in the central part of the Survey Area. These soils formed in wind-laid sands. The native vegetation consists of blue grama, needle-and-thread, and western wheatgrass.

In a typical profile the surface layer is grayish-brown fine sandy loam about 5 inches thick. The subsoil is grayish-brown fine sandy loam about 18 inches thick. The underlying material is light-gray, predominantly massive very fine sandy loam that grades to loamy fine sand.

Permeability is moderately rapid, the available water capacity is moderate, and fertility is medium. The soils are easy to work.

Some areas are used for range, and others are used for dryland and irrigated crops. Crops respond to good management.

In this Survey Area Manter soils are mapped only with Anselmo soils.

Typical profile of Manter fine sandy loam (3 to 6 percent slopes) in native range, 1,220 feet east and 66 feet south of the NW. corner of sec. 17, T. 21 N., R. 61 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, granular structure; soft, very friable; noncalcareous; pH 7.6; clear, smooth boundary.

B2t—5 to 14 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak to moderate, coarse, prismatic structure breaking to moderate, coarse and medium, subangular blocky; slightly hard, very friable; thin, patchy clay films on peds, clay bridges between sand grains, and clay coatings on sand grains; noncalcareous; pH 7.6; gradual, smooth boundary.

B3—14 to 23 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; slightly hard, very friable; noncalcareous; pH 7.6; clear, wavy boundary.

IIC1ca—23 to 34 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, platy structure, in places breaking to weak, medium to fine, angular and subangular blocky; slightly hard, very friable; a weak ca horizon with some visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.0; gradual, smooth boundary.

IIC2ca—34 to 52 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; a weak ca horizon with some visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.4; clear, smooth boundary.

IIIC3ca— 52 to 64 inches, light-gray (10YR 7/2) loamy fine sand, grayish brown (10YR 5/2) moist; massive to single grain; soft, very friable; a weak ca horizon with visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.4.

The color of the A horizon ranges from grayish brown to dark grayish brown. The texture of the C horizon ranges from loamy fine sand to loam.

Manter soils have a B2t horizon, which Anselmo and Vetal soils lack. They have less clay in the B2t horizon than Ascalon soils. They have a thinner A horizon than Vetal soils.

Manter and Anselmo fine sandy loams, 0 to 3 percent slopes (MeA).—Some of these areas consist of Manter fine sandy loam, some of Anselmo fine sandy loam, and some partly of each. Included in mapping

were small areas of Vetal fine sandy loam, Otero fine sandy loam, and Dunday loamy fine sand.

Runoff is slow. In cultivated areas, the hazard of wind erosion is severe, and the hazard of water erosion is slight.

This unit is suited to dryland and irrigated crops, range, windbreaks, and wildlife food and cover. Pheasants and rabbits are plentiful in most areas. Habitat for sharp-tailed grouse, antelope, and deer can be developed.

Winter wheat is the most suitable dryland crop. Oats, barley, and rye are suitable, and alfalfa, grain sorghum, and sudangrass can be grown. Lack of moisture is the main limitation. Wind stripcropping and stubble mulching conserve moisture and control wind erosion.

Corn, beans, sugar beets, potatoes, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. The major limitation is the moderate available water capacity. Include grasses and legumes in the rotation, utilize crop residues and manure, irrigate properly, and apply the right kinds and amounts of fertilizer. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Sandy range site; Sandy windbreak site)

Manter and Anselmo fine sandy loams, 3 to 6 percent slopes (MeB).—The Manter soil has the profile described as typical of the series. The Anselmo soil is similar to Anselmo fine sandy loam, 0 to 6 percent slopes, except for the slope. Included in mapping were small areas of Vetal fine sandy loam, Otero fine sandy loam, and Dunday loamy fine sand.

In cultivated areas the hazard of wind erosion is severe, runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is suited to dryland and irrigated crops, range, windbreaks, and wildlife food and cover.

Tame grasses are well-suited dryland crops. If small grains are grown, use wind stripcropping and stubble mulching to control erosion and conserve moisture. Terraces and contour strips help in controlling water erosion.

All irrigated crops commonly grown in the Area are suitable. Runs of moderate length and contour furrows control erosion and insure even distribution of water. Bench leveling and sprinkling can be used. (Capability unit IVe–5, dryland; IIIe–5, irrigated; Sandy range site; Sandy windbreak site)

Manter and Anselmo fine sandy loams, 6 to 10 percent slopes (MeC).—Except for slope, these soils are similar to Manter and Anselmo fine sandy loams, 3 to 6 percent slopes. The surface layer and the upper part of the subsoil of the Manter soil is about 12 inches thick, and the surface layer of the Anselmo soil is about 12 inches thick. Included in mapping were small areas of Otero fine sandy loam, Dwyer loamy fine sand, and moderately steep Manter and Anselmo fine sandy loams.

Runoff is medium. In cultivated areas the hazard of water erosion is moderate, and the hazard of wind erosion is severe.

These soils are suited to close-growing irrigated crops and can be used for dryland crops. The slope is a limitation on both irrigated and dry cropland. The soils are also suited to range, windbreaks, and wildlife food and cover.

Small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. Contour ditches and proper irrigation control erosion and insure even distribution of water. Sprinkler irrigation can be used.

Tame grasses are suitable dryland crops. Small grains can be grown if erosion is controlled. A combination of terraces, contour strips, and stubble mulch conserves moisture and helps in controlling erosion. (Capability unit IVe–5, dryland; IVe–5, irrigated; Sandy range site; Sandy windbreak site)

Marsh and Wet Land

Marsh and Wet land, 0 to 5 percent slopes (MaB) consists of nearly level to gently sloping areas on flood plains along the North Platte River, Horse Creek and its tributaries, and in swales on adjacent uplands. Included in mapping were areas of poorly drained and very poorly drained soils, of Alkali and saline land, and of Mixed alluvial land. These areas are predominantly deep. They are somewhat poorly drained. The texture is variable.

Unless this unit is properly managed, wind erosion is moderate to very severe. Runoff is slow, and the hazard of water erosion is slight.

These areas are suited to range, wildlife food and cover, some irrigated and dryland crops, and windbreaks.

Native grasses are used for grazing in many places. Grazing must be controlled. Habitat for pheasants, rabbits, antelope, deer, fish, waterfowl, and fur bearers can be developed.

Oats is the most suitable crop in irrigated areas. Manage irrigation water properly, utilize crop residues, and apply the right kinds and amounts of fertilizer.

Dryland areas should be used for hay and tame pasture. If small grains are grown, utilization of crop residues is needed to control soil blowing. (Capability unit IVw–63, dryland; IIIw–63, irrigated; not assigned to a range site; Moderately Wet windbreak site)

McCook Series

The McCook series consists of deep, well-drained, nearly level and very gently sloping soils on flood plains, mainly along the North Platte and the Laramie Rivers, but in a few areas along Horse Creek. These soils formed in water-laid loams, under a cover of short and intermediate grasses.

In a typical profile the surface layer is grayish-brown loam about 12 inches thick. The underlying material is light brownish-gray loam that is stratified with thin lenses of fine sandy loam.

Permeability is moderate, the available water capacity is high, and natural fertility is high. Cultivation is easy.

Most areas are used for irrigated cropland, but a few are still in native vegetation and are used for grazing. Crops respond well to good management.

In this Survey Area McCook soils are mapped only with Haverson soils.

Typical profile of McCook loam (less than 1 percent slopes) in a cultivated field, NE¼SW¼NE¼NE¼ sec. 10, T. 23 N., R. 60 W.:

Ap—0 to 12 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure breaking to moderate, very fine, granular; slightly hard, very friable; calcareous; pH 8.2; clear, smooth boundary.

C—12 to 60 inches +, light brownish-gray (10YR 6/2) loam stratified with thin lenses of fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; calcareous; pH 8.4.

The color of the A horizon ranges from grayish brown to dark grayish brown. The texture of the thin strata in the C horizon ranges from sand to clay loam. In places loose sand and gravel occur below 40 inches.

McCook soils have a darker colored A horizon, when moist, than Haverson, Glenberg, and Bankard soils. They are finer textured throughout than Glenberg and Bankard soils.

Mitchell Series

The Mitchell series consists of deep, well-drained, nearly level to moderately steep soils that formed in water-laid silt on fans and foot slopes and in wind-laid silt on uplands. These soils are the most extensive in the Survey Area. The native vegetation consists of blue grama, threadleaf sedge, and needle-and-thread.

In a typical profile the surface layer is light brownish-gray or light-gray loam about 4 inches thick. It has a high content of lime. The underlying material is light gray loam and has a high content of lime.

Permeability is moderate, the available water capacity is high, and natural fertility is low to medium. Cultivation is easy.

Mitchell soils are used for range and for dryland and irrigated crops. Crops respond to good management (fig. 8).

Typical profile of Mitchell loam (3 percent slopes) in native range, 200 feet east of U.S. Highway 85, NE¼NW¼SE¼NW¼ sec. 6, T. 19 N., R. 61 W.:

A1—0 to 1 inch, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure breaking to moderate, fine, granular; soft, friable; strongly calcareous; pH about 8.0; abrupt, smooth boundary.

AC—1 to 4 inches, light-gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak, thin, platy structure breaking to moderate, fine, granular; slightly hard, friable; strongly calcareous; pH about 8.2; clear, smooth boundary.

C—4 to 60 inches +, light-gray (10YR 7/2) loam, pale brown (10YR 6/3) moist; very weak, medium, subangular blocky structure to massive; slightly hard to hard, friable; many fine and a few medium pores; strongly calcareous; pH about 8.4.

The texture of the A1, AC, and C horizons ranges from loam to silt loam. The color of the A horizon ranges from light gray to grayish brown. The color of the C horizon ranges from light gray to light grayish brown or pale brown.

Mitchell soils are deeper than Keota and Epping soils. They resemble Colby soils but have different mineralogy.

Mitchell-Shingle loams, 0 to 3 percent slopes (MsA).—This complex occurs on uplands in the central and eastern parts of the Survey Area. The Mitchell part makes up 60 to 80 percent of the acreage, and the

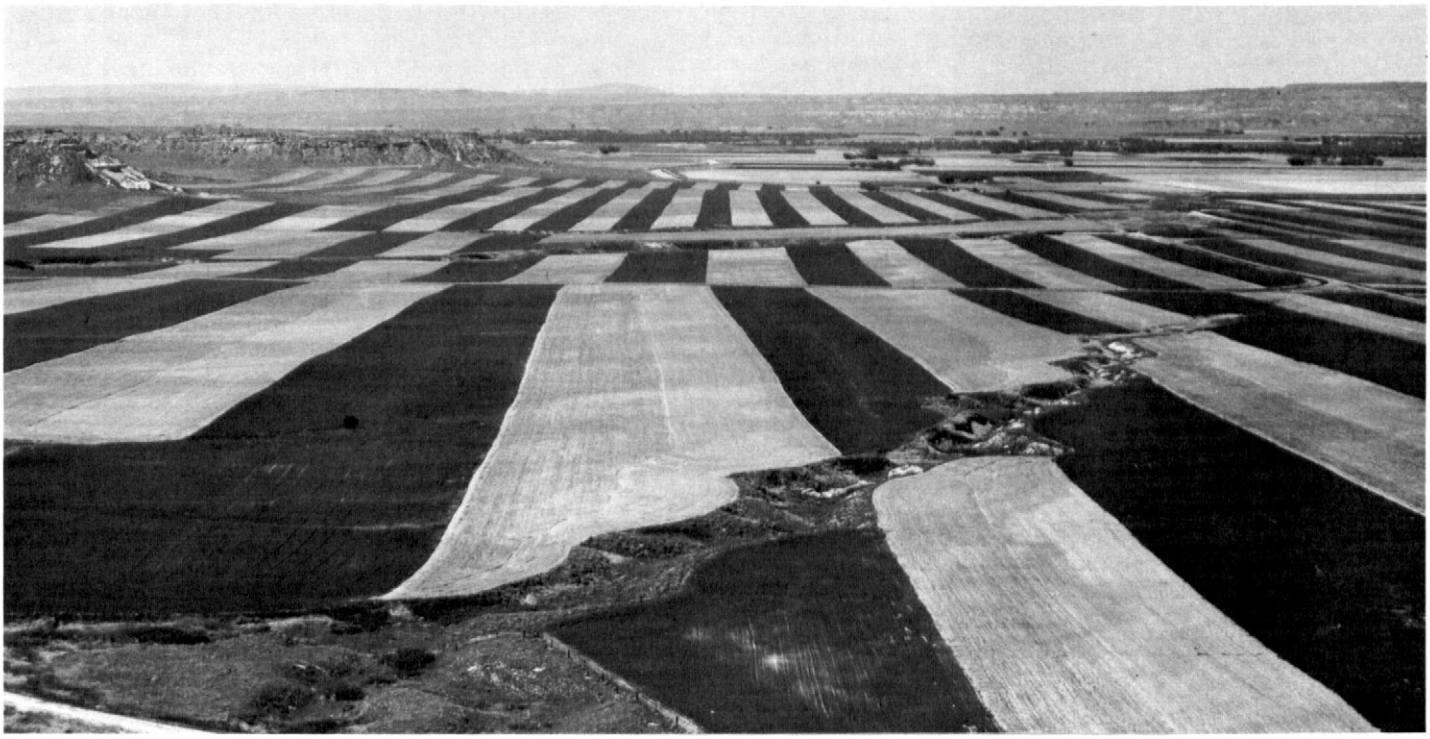

Figure 8.—Wind stripcropping on Mitchell silt loam, capability unit IVe–3, dryland.

Shingle part makes up 20 to 40 percent. The soils have the profiles described as typical of their respective series. Included in mapping were small areas of Anselmo fine sandy loam.

Runoff is slight to medium. In cultivated areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion is severe.

This complex is suited to range, irrigated and dryland crops, and wildlife food and cover. The Mitchell soil is also suited to windbreaks. Shingle soils generally are not suited to cultivation, but in this complex they can be farmed along with Mitchell soils.

Pheasants and rabbits are the principal game species. Habitat for sharp-tailed grouse, antelope, and deer can be developed.

Corn, beans, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. The major limitations are the high content of lime of the Mitchell soils and the shallowness of the Shingle soils. Manage irrigation water properly, include grasses and legumes in the rotation, utilize crop residues and manure, and apply the proper kinds and amounts of fertilizer. Special fertilizers are sometimes needed for crops that are sensitive to lime.

Tame grasses, winter wheat, oats, rye, and barley are suitable dryland crops. The principal limitation is lack of moisture. Use wind stripcropping and stubble mulching to conserve moisture and control erosion. (Mitchell part in capability unit IVe–3, dryland, and IIIe–3, irrigated; Loamy range site; Silty to Clayey windbreak site. Shingle part in capability unit VIs–14, dryland; and IVs–14 irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Mitchell-Shingle loams, 3 to 10 percent slopes (MsC).—Except for slope, this complex is similar to Mitchell-Shingle loams, 0 to 3 percent slopes. The Mitchell part makes up 50 to 70 percent of the acreage, and the Shingle part makes up 30 to 50 percent. Included in mapping were a few small outcrops of sandstone and shale, and small areas of Anselmo fine sandy loam and Otero fine sandy loam.

Runoff is medium to rapid. In cultivated or disturbed areas, the hazard of water erosion is medium to severe and the hazard of wind erosion is severe.

This complex is best suited to range and wildlife food and cover, but it can be used for some irrigated and dryland crops. Mitchell soils can be used for windbreaks.

Close-growing crops are suitable if this soil is irrigated. Slope is the major limitation. Contour ditches control erosion and insure even distribution of water.

Tame grasses are the most suitable dryland crops, but small grains can be grown if erosion is controlled. Slope and lack of moisture are major limitations. (Mitchell part in capability unit IVe–3, dryland and irrigated; Loamy range site; Silty to Clayey windbreak site. Shingle part in capability unit VIe–14, dryland and irrigated; Shallow Loamy range site; Unsuitable windbreak site)

Mitchell silt loam, 0 to 3 percent slopes (MtA).—This soil occurs on fans, foot slopes, and uplands in the north-central, western, and southeastern parts of the Survey Area. It has the profile described as typical for the series. Included in mapping were small areas of Bordeaux fine sandy loam, Keota silt loam, and Alkali and saline land.

In cultivated areas runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion severe.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife food and cover. Pheasants and rabbits are plentiful in many places. Habitat for sharp-tailed grouse, antelope, and deer can be developed. Native grasses are used for grazing in many places.

The principal limitation in irrigated areas is the high content of lime. In places special fertilizers are needed for lime-sensitive crops. Corn, sugar beets, small grains, alfalfa, and alfalfa-grass mixtures are suitable crops. Beans and potatoes can be grown, but are more sensitive to lime than other crops. Manage irrigation water properly, utilize crop residues and manure, include grasses and legumes in the rotation, and apply the right kinds and amounts of fertilizer.

Tame grasses, winter wheat, oats, barley, and rye are suitable dryland crops. Lack of moisture is the principal limitation. Wind stripcropping and stubble mulching conserve moisture and control erosion. (Capability unit IVe–3, dryland, and IIe–3, irrigated; Loamy range site; Silty to Clayey windbreak site)

Mitchell silt loam, 3 to 6 percent slopes (MtB).—Except for slope, this soil is similar to Mitchell silt loam, 0 to 3 percent slopes. Included in mapping were small areas of Keota silt loam, Otero fine sandy loam, and Alkali and saline land.

Runoff is medium. In cultivated areas, the hazard of water erosion is moderate and the hazard of wind erosion severe.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife habitat.

Corn, sugar beets, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. Beans and potates can be grown, but they do not grow as well as other crops because of the high content of lime. Slope is the principal limitation. Irrigation runs of moderate length and contour furrows distribute water evenly and help in controlling water erosion. Bench leveling and sprinkler irrigation can be used.

Tame grasses are the most suitable dryland crop, but small grains can be grown. If small grains are grown, use wind stripcropping and maximum amounts of stubble mulch to conserve moisture and control erosion. Terraces and contour strips help in controlling water erosion. (Capability unit IVe–3, dryland; IIIe–3, irrigated; Loamy range site; Silty to Clayey windbreak site)

Mitchell silt loam, 6 to 10 percent slopes (MtC).—Except for slope, this soil is similar to Mitchell silt loam, 0 to 3 percent slopes. Included in mapping were small areas of Keota silt loam, Otero fine sandy loam, and Epping silt loam.

In cultivated areas runoff is rapid and the hazard of water and wind erosion is severe.

This soil is suited to range, windbreaks, wildlife habitat, close-growing irrigated crops, and dryland crops.

Alfalfa, alfalfa-grass mixtures, and small grains are suitable irrigated crops. Slope is the principal limitation. Use contour ditches or sprinklers and manage irrigation water properly to distribute water evenly and to help control water erosion.

Tame grasses are the most suitable dryland crop. Shortage of moisture and slope are the major limitations. Small grains can be grown if terraces, contour strips, and stubble mulch are used to conserve moisture and to control erosion. (Capability unit IVe–3, dryland; IVe–3, irrigated; Loamy range site; Silty to Clayey windbreak site)

Mitchell silt loam, 10 to 15 percent slopes (MtD).—Except for slope, this soil is similar to Mitchell silt loam, 0 to 3 percent slopes. Included in mapping were small areas of Keota silt loam and Epping silt loam.

Runoff is rapid to very rapid. In areas where this soil is plowed or otherwise disturbed, the hazard of water erosion is very severe and the hazard of wind erosion is severe.

This soil is suited to range, windbreaks, wildlife habitat, and irrigated hay and pasture.

Alfalfa, alfalfa-grass mixtures, and grasses are suitable crops. Slope is the principal limitation. Use controlled flooding or sprinkling to insure even distribution of water and to help control water erosion. (Capability unit VIe–3, dryland; VIe–3, irrigated; Loamy range site; Silty to Clayey windbreak site)

Mixed Alluvial Land

Mixed alluvial land (Mu) consists of well-drained, nearly level to hummocky sands and gravel on flood plains, mainly along the North Platte and the Laramie Rivers. There are also a few small areas on Horse Creek. Included in mapping were small areas of Bankard loamy fine sand, Glenberg fine sandy loam, and Marsh and Wet land.

Mixed alluvial land is well suited to wildlife habitat (fig. 9). Habitat for pheasants, rabbits, deer, waterfowl, fur bearers, and fish can be developed. This land is also suited to range, and it is a good source of sand and gravel. (Capability unit VIIs–6, dryland; not assigned to a range site or windbreak site)

Norka Series

The Norka series consists of deep, well-drained, nearly level to sloping soil on uplands. These soils occur on tablelands in the western and southern parts of the Survey Area, and in some places in the east-central part. They formed in wind-laid silt. The native vegetation consists of blue grama, western wheatgrass, needle-and-thread, and Sandberg bluegrass.

In a typical profile the surface layer is grayish-brown loam about 3 inches thick. The upper part of the subsoil is grayish-brown to brown light clay loam about 9 inches thick. The lower part of the subsoil is pale-yellow loam about 7 inches thick. It has a high content of lime. The underlying material is pale-yellow to light-gray loam that grades to very fine sandy loam.

Figure 9.—**A good cover of grasses, shrubs, and trees on Mixed alluvial land.**

Permeability is moderate, and the available water capacity is high. The soils are naturally fertile. Cultivation is easy.

Norka soils are used for dryland crops and for range. Crops respond well to good management.

Typical profile of Norka loam, 0 to 1 percent slopes, in native range, 185 feet west and 140 feet south of the NE. corner of sec. 29, T. 19 N., R. 61 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong, very fine, granular structure; soft, very friable; noncalcareous; pH 7.4; clear, smooth boundary.

B21t—3 to 7 inches, grayish-brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, very friable; moderate numbers of thin, patchy clay films on peds; noncalcareous; pH 7.6; clear, smooth boundary.

B22t—7 to 12 inches, brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, very friable; many thin, patchy clay films on peds; noncalcareous; pH 7.8; gradual, smooth boundary.

B3ca—12 to 19 inches, pale-yellow (2.5Y 7/3) loam, light olive brown (2.5Y 5/3) moist; weak, medium, subangular blocky structure; slightly hard, very friable; a few, thin, patchy clay films principally on vertical faces of peds; a very weak ca horizon that has visible secondary calcium carbonate occurring as thin seams and streaks; calcareous; pH 8.2; gradual, smooth boundary.

C1ca—19 to 30 inches, pale-yellow (2.5Y 7/3) loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable; a weak ca horizon that has visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.5; gradual, smooth boundary.

C2ca—30 to 40 inches, light-gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable; a weak ca horizon that has visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 8.6; gradual, smooth boundary.

C3ca—40 to 50 inches, light-gray (2.5Y 7/2) very fine sandy loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable; a weak ca horizon that has visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 9.0; gradual, smooth boundary.

C4ca—50 to 62 inches, light-gray (2.5Y 7/2) very fine sandy loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable; a very weak ca horizon that has visible calcium carbonate occurring as concretions and thin seams and streaks; calcareous; pH 9.0.

The color of the A horizon ranges from grayish brown to dark grayish brown or dark brown. The texture of the B2t horizon ranges from heavy loam to clay loam.

Norka soils have a thinner A horizon and a thinner B horizon than Keith soils. They have weaker structure and less clay in the B horizon than Weld soils.

Norka loam, 0 to 1 percent slopes (NoA).—This soil occurs on tablelands in the western and southern parts of the Survey Area. A few areas are on Table Mountain. This soil has the profile described as typical for the series. Included in mapping were small areas of Weld loam, Keith loam, and Goshen loam.

Runoff is slow. The erosion hazard is slight.

This soil is suited to dryland crops, range, windbreaks, and wildlife habitat. No water is available for irrigation. Habitat can be developed for pheasant, sharp-tailed grouse, rabbits, antelope, and deer. Native grasses are used for grazing in many places.

Winter wheat, oats, barley, and rye are suitable dryland crops, but alfalfa, corn, and grain sorghum can be grown. Shortage of moisture is the principal limitation. Use wind stripcropping and summer fallow to conserve moisture. (Capability unit IIIc–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Norka loam, 1 to 6 percent slopes (NoB).—Except for slope, this soil is similar to Norka loam, 0 to 1 percent slopes. In most cultivated fields, plowing has mixed the surface layer with the upper part of the subsoil. In some places deep plowing and erosion have exposed light-colored limy material. Included in mapping were small areas of Ulysses loam, Keith loam, and Weld loam.

In cultivated areas runoff is slow to medium, the hazard of water erosion is slight to moderate, and the hazard of wind erosion is moderate.

This soil is suited to range, dryland crops, windbreaks, and wildlife habitat.

Small grains are suitable dryland crops. Shortage of moisture is the principal limitation. Use wind stripcropping and stubble mulching to conserve moisture and control erosion. Terraces, contour strips, and stubble mulch help in controlling erosion on the steeper slopes. (Capability unit IIIe–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Norka and Colby loams, 0 to 6 percent slopes (NrB).—This unit occurs on uplands in the southwestern part of the Survey Area. Some of these areas consist of Norka loam, some of Colby loam, and some partly of each. Each soil has the profile described as typical for the respective series. In most cultivated fields, however, the surface layer of the Norka soil has been mixed with the upper part of the subsoil, and in some places deep plowing and erosion have exposed light-colored limy material. Included in mapping were small areas of Rosebud loam, Goshen-Kuma loams, and Tassel fine sandy loam.

Runoff is slow to medium. In cultivated areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion is moderate to severe.

This unit is suited to range, windbreaks, and wildlife habitat. Habitat for pheasant, sharp-tailed grouse, antelope, and deer can be developed. The soils can also be used for dryland crops.

Tame grasses are the most suitable crop, but winter wheat, oats, barley, and rye can be grown. Shortage of moisture is the principal limitation. Use wind strip crops and stubble mulch to control erosion and conserve moisture. Terraces, contour strips, and stubble mulch help control water erosion on the steeper slopes. (Norka part in capability unit IIIe–2, dryland; Loamy range site. Colby part in capability unit IVe–3; Limy Upland range site. Both soils in Silty to Clayey windbreak site)

Norka-Weld loams, 0 to 6 percent slopes (NwB).—This complex occurs on uplands in the western and southwestern parts of the Survey Area. The Norka part makes up 40 to 60 percent of the acreage, and the Weld part makes up 40 to 60 percent. Each soil has the profile described as typical of the respective series. In

many cultivated fields plowing has mixed the surface layer with the upper part of the subsoil, and small eroded spots of light-colored limy material are commonly exposed at the surface. Included in mapping were small areas of Goshen-Kuma loams, Duroc loam, and Colby loam.

Runoff is slow to medium. In cultivated areas, the hazard of water erosion is slight to medium and the hazard of wind erosion is moderate.

This complex is suited to dryland crops, range, windbreaks, and wildlife habitat. Habitat for pheasant, sharp-tailed grouse, rabbits, antelope, and deer can be developed.

Winter wheat, oats, barley, and rye are suitable crops. Alfalfa, corn, and grain sorghum can be grown in nearly level areas. Shortage of moisture is the principal limitation. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion. Terraces on the gently sloping areas help in controlling water erosion. (Capability unit IIIe–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Norka-Weld loams, 6 to 10 percent slopes (NwC).—Except for slope and a combined thickness of 11 inches for the surface layer and upper part of the subsoil, this complex is similar to Norka-Weld loams, 0 to 6 percent slopes. The Norka part makes up 60 to 80 percent of the acreage, and the Weld part makes up 20 to 40 percent. Included in mapping were small areas of Rosebud loam, Colby loam, and Tassel fine sandy loam.

Runoff is medium to rapid. In cultivated areas, the hazard of water erosion is severe and the hazard of wind erosion moderate.

This complex is suited to range, windbreaks, and wildlife habitat. It can be used for dryland crops.

Tame grasses are well suited. Small grains can be grown if erosion is controlled. Slope and the shortage of moisture are the major limitations. Terraces, contour strips, and stubble mulch conserve moisture and control erosion. (Capability unit IVe–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Orella Series

The Orella series consists of shallow, well-drained, nearly level to moderately steep soils on uplands in the western, central, and eastern parts of the Survey Area. These soils formed in clays that weathered in place from soft shale. The native vegetation is dominantly western wheatgrass.

In a typical profile the surface layer is light-gray clay about 4 inches thick. It is strongly alkaline. The next horizon is light brownish-gray clay about 8 inches thick. It is very strongly alkaline. The underlying material is partly weathered, strongly alkaline clay shale.

Permeability is slow. Orella soils are not suited to cultivation, but are suited to range. Some areas are suited to the development of habitat for waterfowl.

Typical profile of Orella clay, 0 to 3 percent slopes, in wheatgrass pasture, 319 feet east and 105 feet north of the SW. corner of sec. 20, T. 23 N., R 61 W.:

A1—0 to 4 inches, light-gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; moderate to strong, very fine, granular structure; hard, firm; a vesicular crust in the uppermost quarter inch; calcareous; pH 9.0; clear, smooth boundary.

C—4 to 12 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; weak, coarse, angular blocky structure breaking to weak, fine, angular blocky; extremely hard, firm, very plastic; calcareous; pH 9.4; gradual, wavy boundary.

R1—12 to 17 inches, light-gray (2.5Y 7/2) partly weathered clay shale, grayish brown (2.5Y 5/2) moist; approximately 90 percent shale chips; weak accumulation of secondary calcium carbonate and calcium sulfate occurring as crystals and seams; calcareous; pH 9.2; diffuse, wavy boundary.

R2—17 to 29 inches, weak, weathered shale beds.

The color of the A horizon ranges from light gray to light brownish gray. The color of the C horizon ranges from light brownish gray or pale brown to light gray. The depth to soft shale ranges from 8 to 20 inches.

Orella soils are shallower than Heldt soils and have a higher pH value. They are shallower and finer textured than Kim soils and are more strongly alkaline in the A horizon than those soils.

Orella clay, 0 to 3 percent slope (OcA).—This soil occurs on upland flats and basins in the western, central, and eastern parts of the Survey Area. It has the profile described as typical of the Orella series. Included in mapping were small areas of Kim clay loam, alkali, 0 to 1 percent slopes; Alkali and saline land; and a few small areas of soft shale bedrock.

Runoff is slow. In plowed or otherwise disturbed areas, the hazard of water erosion is slight and the hazard of wind erosion is slight to moderate.

This soil is suited to range and wildlife habitat. It can be used for irrigated hay and pasture. It is well suited to habitat for antelope, sharp-tailed grouse, pheasants, and rabbits. The nearly level basin areas that have good management can be developed for waterfowl.

Most areas are used for range. Tillage and establishment of cover are difficult in irrigated areas. Use perennial grasses and legumes, manage irrigation water properly, and apply the right kinds and amounts of fertilizer. (Capability unit VIs–14, dryland; VIs–14, irrigated; Saline Upland range site; Unsuitable windbreak site)

Orella and Epping soils, 3 to 15 percent slopes (OeD).—This unit occurs on uplands in the western and central parts of the Survey Area. Some of these areas consist of Orella clay, some of Epping silt loam, and some partly of each. The soils are similar to those described as typical of their respective series. Included in mapping were small areas of Kim clay loam, alkali; Keota silt loam; and soft shale and siltstone bedrock.

In areas that have been disturbed, or areas where the vegetation has been destroyed, the hazard of water erosion is moderate to severe and the hazard of wind erosion is moderate.

This unit is suited to range and wildlife food and cover. (Both soils in Capability unit VIIe–14, dryland, and Unsuitable windbreak site. Orella part in Saline Upland range site: Epping part in Shallow Loamy range site.

Otero Series

The Otero series consists of deep, well-drained soils in the western, central, and eastern parts of the Survey Area. They formed in wind-laid sands on nearly level to

sloping uplands and in water-laid sands on fans and foot slopes. The native vegetation consists of blue grama, needle-and-thread, and Indian ricegrass.

In a typical profile the surface layer is grayish-brown fine sandy loam about 5 inches thick. The next layer is grayish-brown fine sandy loam about 10 inches thick. The underlying material is pale brown to very pale brown fine sandy loam.

Permeability is moderately rapid, the available water capacity is moderate, and the natural fertility is low. Cultivation is easy.

Otero soils are well suited to range. Some areas are used for dryland and irrigated crops. Crops respond to good management.

Typical profile of Otero fine sandy loam, 3 to 6 percent slopes, in native range, 600 feet west of the north quarter corner of sec. 10, T. 23 N., R. 64 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure; soft, friable; calcareous; pH about 8.0; clear, smooth boundary.

AC—5 to 15 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak, coarse, prismatic structure breaking to very weak, medium, subangular blocky and very weak, fine, crumb; hard, friable; common fine pores; calcareous; pH about 8.0; gradual, wavy boundary.

C1—15 to 30 inches, pale-brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; calcareous; pH about 8.0; gradual, wavy boundary.

C2— 30 to 60 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; hard, friable; strongly calcareous; pH about 8.4.

The color of the A horizon ranges from grayish brown to light grayish brown. The color of the AC horizon ranges from grayish brown to light grayish brown and pale brown. When moist, the A horizon is lighter colored than that of Anselmo and Bayard soils.

Otero fine sandy loam, 0 to 3 percent slopes (OtA).—This soil occurs on uplands, fans, and foot slopes in the western, central, and eastern parts of the Survey Area. Except for slope, this soil has a profile similar to that described as typical for the series. Included in mapping were small areas of Dwyer loamy fine sand, Anselmo fine sandy loam, and Mitchell silt loam.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion is severe.

This soil is suited to dryland and irrigated crops, range, windbreaks, and wildlife food and cover. Native grasses are used for grazing in many places. Pheasants are common in irrigated areas, and rabbits are plentiful. Habitat for sharp-tailed grouse, antelope, and deer can be developed.

Tame grasses, winter wheat, oats, rye, and barley are suitable dryland crops. Lack of moisture is the principal limitation. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion.

Corn, beans, sugar beets, potatoes, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. The principal limitation is moderate available water capacity. Manage irrigation water properly, include grasses and legumes in the rotation, utilize crop residue, and apply the right kinds and amounts of fertilizer to insure good yields, control erosion, and maintain fertility, soil structure, and organic-matter content. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Sandy range site; Sandy windbreak site)

Otero fine sandy loam, 3 to 6 percent slopes (OtB).—This soil has the profile described as typical of the series. Included in mapping were small areas of Anselmo fine sandy loam and Dwyer loamy fine sand.

Runoff is slow to medium. The hazard of water erosion is slight to moderate, and the hazard of wind erosion is severe in cultivated areas.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife food and cover.

The irrigated crops commonly grown in this Area are suited. Slope is the principal limitation. Use irrigation runs of moderate length and contour furrows to insure even distribution of water and to control erosion. Bench leveling and sprinkler irrigation are suited.

Tame grasses are well-suited dryland crops; winter wheat, oats, barley, and rye also are suited. Use alternating strips of crops and summer fallow to conserve moisture and control erosion if small grains are grown. (Capability unit IVe–5, dryland; IIIe–5 irrigated; Sandy range site; Sandy windbreak site)

Otero fine sandy loam, 6 to 10 percent slopes (OtC).—Included with this soil in mapping were small areas of Dwyer loamy fine sand and Anselmo fine sandy loam.

Runoff is medium. The hazard of water erosion is moderate to severe, and the hazard of wind erosion is severe in cultivated areas.

This soil is suited to close-growing irrigated crops, range, windbreaks, and wildlife food and cover.

Alfalfa, alfalfa-grass mixtures, and small grains are suitable crops. The major limitation is slope. Use contour ditches and manage irrigation water properly to insure even distribution of water and help control water erosion. Sprinkler irrigation is suitable. (Capability unit VIe–5, dryland; IVe–5, irrigated; Sandy range site; Sandy windbreak site)

Rock Land

Rock land (Rc) occurs as moderately steep to steep areas on uplands in the southern and western parts of the Survey Area. It consists of outcrops of soft sandstone and areas of Tassel fine sand loam, Trelona fine sandy loam, Dunday loamy fine sand, and Dwyer loamy fine sand, most of which occur in each area in varying amounts (fig. 10). Each of these soils has a profile similar to that described as typical of the respective series. Included in mapping were small areas of Rosebud fine sandy loam, Anselmo fine sandy loam, Mitchell silt loam, Epping silt loam, and a few areas of soft siltstone.

Rock land is suited to range and wildlife habitat. Nearly all of the acreage is used for range. Deer and rabbits are the principal game species. Habitat for sharp-tailed grouse and antelope can be developed. Erosion is severe to very severe in disturbed areas or in areas where vegetation is destroyed. (Rock outcrop part in capability unit VIIIs–83, dryland. Tassel and

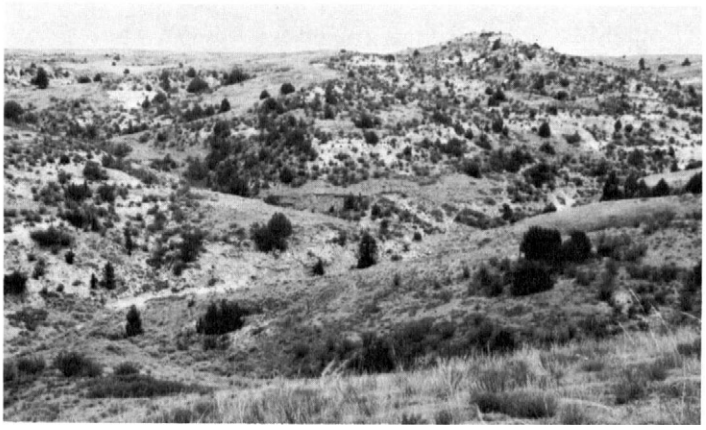

Figure 10.—**An area of Rock land. The light-colored areas in the background are sandstone outcrops; the steep slopes are mostly Tassel fine sandy loam and Trelona fine sandy loam. The draw in the center is Dunday loamy fine sand and Dwyer loamy fine sand. The foreground is Anselmo fine sandy loam.**

Trelona parts in capability unit VIIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site. Dunday and Dwyer parts in capability unit VIe–4, dryland; Sandy range site; Very Sandy windbreak site)

Rock Outcrop-Tassel Complex

Rock outcrop-Tassel complex (Rd) consist of outcrops of soft sandstone and Tassel fine sandy loam. It occurs on steep breaks and escarpments in the western and southern parts of the Survey Area. The Rock outcrop part makes up 40 to 70 percent of the acreage, and the Tassel part makes up 30 to 60 percent. The Tassel soil has the profile described as typical for the Tassel series. Included in mapping were small areas of Trelona fine sandy loam.

This complex is well suited to wildlife habitat. It provides excellent habitat for deer, which is the principal species. It has limited use for range. Most areas are used for range but some are inaccessible to livestock. (Tassel part in capability unit VIIe–14 dryland; Shallow Sandy range site. Rock outcrop part in capability unit VIIIs–83, dryland; not assigned to a range site. Both soils in Unsuitable windbreak site)

Rosebud Series

The Rosebud series consists of moderately deep, well-drained, nearly level to moderately steep soils on tableland in the western and southwestern parts of the Survey Area. These soils formed in material that weathered in place from soft, calcareous sandstone. The native vegetation consists of blue grama, needle-and-thread, and buffalograss.

In a typical profile the surface layer is dark grayish-brown fine sandy loam about 3 inches thick. The upper part of the subsoil, about 8 inches thick, is sandy clay loam that grades from dark brown to brown. The lower part of the subsoil is very pale brown very fine sandy loam about 13 inches thick. It is high in content of lime. The underlying material is massive, very pale brown very fine sandy loam that also is high in content of lime. Soft, calcareous sandstone is a depth of about 39 inches.

These soils are naturally fertile. Permeability is moderate, and the available water capacity is moderate. Cultivation is easy.

Rosebud soils are well suited to range and dryland crops. Crops respond to good management. Many areas are used for grazing.

Typical profile of Rosebud fine sandy loam (less than 1 percent slopes), 28 feet north and 165 feet west of the center of sec. 14, T. 21 N., R. 65 W.:

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; soft, very friable; noncalcareous; pH about 7.2; abrupt, smooth boundary.

B21t—3 to 7 inches, dark-brown (10YR 4/3) sandy clay loam, dark yellowish brown (10YR 3/4) moist; moderate, fine to medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable, sticky; thin, patchy clay films on peds; a few fine pores; noncalcareous; pH about 7.2; clear, smooth boundary.

B22t—7 to 11 inches, brown (10YR 5/3) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable, sticky; thin, patchy clay films on peds; common fine pores; noncalcareous; pH about 7.2; abrupt, smooth boundary.

B3ca—11 to 24 inches, very pale brown (10YR 7/3) very fine sandy loam, grayish brown (10YR 5/2) moist; very weak, medium, prismatic structure breaking to weak, medium, subangular blocky; slightly hard, friable; common fine pores; moderate calcium accumulation, disseminated lime; strongly calcareous; pH about 8.4; gradual, wavy boundary.

Cca—24 to 39 inches, very pale brown (10YR 7/3) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft to slightly hard, friable; a few sandstone fragments; weak calcium accumulation; strongly calcareous; pH about 8.4; abrupt, wavy boundary.

R—39 inches +, soft, calcareous sandstone.

The texture of the A horizon ranges from loamy fine sand to loam, and the color from dark grayish brown to grayish brown. The depth to soft sandstone ranges from 20 to 40 inches.

Rosebud soils differ from Hargreave soils in having a zone of calcium carbonate accumulation. They are shallower than Satanta soils. They are shallower than Norka soils and have more sand in the B horizon. They are deeper than Trelona soils.

Rosebud-Dunday-Trelona loamy fine sands, 0 to 3 percent slopes (ReA).—This complex occurs on uplands in the southwestern part of the Survey Area. The Rosebud part makes up 20 to 60 percent of the acreage; the Dunday part, 20 to 60 percent; and the Trelona part, 20 to 60 percent. The Rosebud soil is similar to the soil described as typical for the Rosebud series except that the surface layer is loamy fine sand about 6 to 8 inches thick. The Dunday soil has the profile described as typical for the Dunday series. The Trelona soil is similar to the soil described as typical for the Trelona series except that the surface layer is loamy fine sand 6 to 8 inches thick. Included in mapping were small areas of Creighton very fine sandy loam and Dwyer loamy fine sand.

Runoff is slow. In cultivated or otherwise disturbed areas, the hazard of wind erosion is very severe and the hazard of water erosion is slight.

This complex is suited to range, wildlife habitat, and dryland crops. Rosebud and Dunday soils are suited to windbreaks. Habitat can be developed for sharp-tailed grouse, rabbits, antelope, and deer. Nearly all areas are used for range.

Tame grasses are well-suited dryland crops, but small grains can be grown if wind erosion is controlled. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion if small grains are grown. Lack of moisture is the major limitation. (Rosebud and Dunday parts in capability unit IVe–4, dryland; Sandy range site; Sandy windbreak site. Trelona part in capability unit VIs–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Rosebud-Dunday-Trelona loamy fine sands, 3 to 10 percent slopes (ReC).—Except for slope, this complex is similar to Rosebud-Dunday-Trelona loamy fine sands, 0 to 3 percent slopes. The Rosebud part makes up 20 to 60 percent of the acreage; the Dunday part, 20 to 60 percent; and the Trelona part, 20 to 60 percent. Included in the mapping were small areas of Dwyer loamy fine sand, Tassel fine sandy loam, and a few small outcrops of soft sandstone.

This complex is suited to range and wildlife habitat. Rosebud and Dunday soils can be used for windbreaks. In disturbed areas or areas where the vegetation is destroyed, the hazard of wind erosion is very severe. (Rosebud and Dunday parts in capability unit VIe–4, dryland; Sandy range site; Very Sandy windbreak site. Trelona part in capability unit VIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Rosebud and Hargreave fine sandy loams, 0 to 6 percent slopes (RhB).—These soils are on uplands in the western and southwestern parts of the Survey Area. Some of these areas consist of Rosebud fine sandy loam, some of Hargreave fine sandy loam, and some partly of each. The Rosebud soil is similar to the soil described as typical for the Rosebud series except that in some cultivated areas the original surface layer has been mixed with the upper part of the subsoil. The Hargreave soil is similar to the soil described as typical for the Hargreave series except that the surface layer is fine sandy loam. Included in mapping were small areas of Creighton very fine sandy loam, Trelona fine sandy loam, and Tassel fine sandy loam.

Runoff is slow to medium. In cultivated areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion is severe.

This unit is suited to dryland crops, range, windbreaks, and wildlife food and cover. It is suited to habitat for pheasants, sharp-tailed grouse, rabbits, deer, and antelope. Native grasses are used for grazing in some places.

Winter wheat, oats, rye, and barley are suitable dryland crops. Corn, alfalfa, and grain sorghum can be grown in the nearly level areas but are not so well suited as small grains. Lack of moisture is the major limitation. Use wind stripcropping and stubble mulching to conserve moisture and control erosion. Terraces help in controlling water erosion on the steeper slopes. (Capability unit IIIe–5, dryland; Loamy range site; Sandy windbreak site)

Rosebud and Hargreave fine sandy loams, 6 to 10 percent slopes (RhC).—Except for slope, this unit is similar to Rosebud and Hargreave fine sandy loams, 0 to 6 percent slopes. Included in mapping were small areas of Trelona fine sandy loam and Tassel fine sandy loam.

Runoff is medium to rapid. In cultivated areas, the hazards of water and wind erosion are severe.

This unit is suited to range, windbreaks, and wildlife habitat, and it can be used for dryland crops.

Tame grasses for hay or pasture is the most suitable dryland crop. Small grains can be grown if erosion is controlled. Use a combination of terraces, contour strips, and stubble mulch to control erosion and conserve moisture. Slope and lack of moisture are the major limitations. (Capability unit IVe–5, dryland; Loamy range site; Sandy windbreak site)

Rosebud and Norka loams, 0 to 1 percent slopes (RnA).—These soils are on uplands in the western and southern parts of the Survey Area. Some areas consist of Rosebud loam, some of Norka loam, and some partly of each. The Rosebud soil is similar to the soil described as typical for the Rosebud series except that the surface layer is loam or very fine sandy loam. The Norka soil has the profile described as typical for the Norka series. Included in mapping were small areas of Hargreave very fine sandy loam, Weld loam, and Goshen-Kuma loams.

Runoff is slow. In cultivated areas the erosion hazard is slight.

This unit is suited to dryland crops, range, windbreaks, and wildlife food and cover. It is suited to habitat for sharp-tailed grouse, antelope, and deer. Pheasants and rabbits are the principal game species.

Winter wheat, oats, barley, and rye are suitable dryland crops. Alfalfa, corn, and grain sorghum can also be grown. Use alternate strips of crops and stubble mulch to conserve moisture. (Capability unit IIIc–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Rosebud and Norka loams, 1 to 6 percent slopes (RnB).—Except for slope and cultivated areas where the original surface layer has been mixed with the upper part of the subsoil, this unit is similar to Rosebud and Norka loams, 0 to 1 percent slopes. Light-colored limy material is exposed in a few small eroded spots. Included in mapping were small areas of Hargreave very fine sandy loam, Trelona fine sandy loam, and Tassel fine sandy loam.

This unit is suitable for dryland crops, range, windbreaks, and wildlife food and cover.

Lack of moisture is the major limitation in dryland areas. Small grains are suitable crops. Use wind stripcropping and stubble mulching to conserve moisture and control erosion. Terraces help in controlling water erosion on the stronger slopes. (Capability unit IIIe–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Rosebud and Norka loams, 6 to 10 percent slopes (RnC).—Except for slope, this unit is similar to Rosebud and Norka loams, 1 to 6 percent slopes. Included

in mapping were small areas of Trelona fine sandy loam and Tassel fine sandy loam and a few areas of moderately steep Rosebud and Norka loams.

Runoff is moderate to rapid. In cultivated areas, the hazard of water erosion is severe and the hazard of wind erosion is moderate.

This unit is suited to range, windbreaks, and wildlife food and cover, and it can be used for dryland crops.

Slope and lack of moisture are the principal limitations in dryland areas. Tame grasses for hay or pasture are well suited, but winter wheat, oats, barley, and rye can be grown. Use a combination of terraces, contour strips, and stubble mulch to conserve moisture and control erosion if small grains are grown. (Capability unit IVe–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Rosebud and Satanta loams, 0 to 3 percent slopes (RsA).—This unit occurs on tableland in the southwestern part of the Survey Area. Rosebud soils occupy the microridges, and Satanta soils the nearly level slopes and swales. Some areas consist of Rosebud loam, some of Satanta loam, and some partly of each. The Rosebud soil has a surface layer of loam or very fine sandy loam but is otherwise similar to the soil described as typical for the Rosebud series. The Satanta soil has the profile described as typical for the Satanta series. There are a few small eroded spots of light-colored limy material exposed on the crests of the small ridges. Included in mapping were small areas of Goshen-Kuma loams and Hargreave very fine sandy loam.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion is moderate.

This unit is suited to dryland crops, range, windbreaks, and wildlife food and cover. It is well suited to habitat for pheasants, sharp-tailed grouse, rabbits, deer, and antelope. Native grasses are used for grazing in some places.

Winter wheat, oats, barley, and rye are suitable dryland crops. Corn, alfalfa, and grain sorghum can also be grown. Lack of moisture is the major limitation. Use alternate strips of crops and stubble mulch to conserve moisture and control erosion. (Capability unit IIIe–2, dryland; Loamy range site; Silty to Clayey windbreak site)

Rosebud-Trelona complex, 0 to 6 percent slopes (RtB).—This complex consists of Rosebud loam and Trelona fine sandy loam. The Rosebud part makes up 60 to 80 percent of the acreage, and the Trelona part, 20 to 40 percent. The Rosebud soil is similar to the soil described as typical for the Rosebud series except that the surface layer is loam or very fine sandy loam and in some cultivated areas the original surface layer has been mixed with the upper part of the subsoil. The Trelona soil has the profile described as typical for the Trelona series. A few small outcrops of soft sandstone occur in the Trelona soil. These soils are on uplands in the western and southern parts of the Survey Area. Included in mapping were small areas of Hargreave very fine sandy loam and Tassel fine sandy loam.

Runoff is slow to medium. In cultivated areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion is moderate.

This complex is suited to range and wildlife habitat, and it can be used for dryland crops. The Rosebud soil is suited to windbreaks. Trelona soils are not generally suited to cultivation, but the pattern of their occurrence in this complex permits limited cultivation. Habitat for pheasants, sharp-tailed grouse, rabbits, antelope, and deer can be developed. Most areas are used for range.

Tame grasses for hay or pasture are well suited. Small grains can be grown if erosion is controlled. Lack of moisture is the principal limitation in dryland areas. Wind stripcropping and stubble mulching conserve moisture and help control erosion. (Rosebud part in capability unit IIIe–2, dryland; Loamy range site; Silty to Clayey windbreak site. Trelona part in capability unit VIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Rosebud-Trelona fine sandy loams, 0 to 6 percent slopes (RuB).—Each soil has the profile described as typical of the respective series. The Rosebud part makes up 60 to 80 percent of the acreage, and the Trelona part makes up 20 to 40 percent. Included in mapping were small areas of Hargreave fine sandy loam and Tassel fine sandy loam and a few small outcrops of soft sandstone.

Runoff is slow to moderate. In cultivated or otherwise disturbed areas, the hazard of water erosion is slight to moderate and the hazard of wind erosion is severe.

This complex is suited to range and wildlife food and cover, and it can be used for dryland crops. The Rosebud soil is suited to windbreaks. The Trelona soil is not generally suited to cultivation, but it can be farmed in this complex in order to maintain good field alinement. Native grasses are used for grazing in most areas. Habitat for pheasants, sharp-tailed grouse, rabbits, antelope, and deer can be developed.

Tame grasses for hay or pasture are well-suited dryland crops. Small grains can be grown. Lack of moisture is the principal limitation. If small grains are grown, use wind stripcropping and stubble mulching to conserve moisture and control erosion. (Rosebud part in capability unit IIIe–5, dryland; Loamy range site; Sandy windbreak site. Trelona part in capability unit VIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Rosebud-Trelona fine sandy loams, 6 to 10 percent slopes (RuC).—Except for slope and cultivated areas where the original surface layer of the Rosebud soil has been mixed with the upper part of the subsoil, this complex is similar to Rosebud-Trelona fine sandy loams, 0 to 6 percent slopes. The Rosebud part makes up 50 to 70 percent of the acreage, and the Trelona part makes up 30 to 50 percent. Several small areas of light-colored limy material have been exposed by erosion. Included in mapping were small areas of Tassel fine sandy loam and Hargreave fine sandy loam. Small outcrops of soft sandstone are common.

Runoff is medium. If this complex is plowed or otherwise disturbed, the hazard of water erosion is moderate to severe and the hazard of wind erosion is severe.

This complex is suited to range, wildlife food and cover, and tame grasses for dryland hay or pasture. The Rosebud soil is suited to windbreaks. Adequate erosion control for growing small grains is generally not practical. (Rosebud part in capability unit IVe–5, dryland; Loamy range site; Sandy windbreak site. Trelona part in capability unit VIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Rosebud-Trelona fine sandy loams, 10 to 20 percent slopes (RuD).—Except for slopes and a higher percentage of Trelona soils, this complex is similar to Rosebud-Trelona fine sandy loams, 6 to 10 percent slopes.

The Rosebud part makes up 40 to 60 percent of the acreage, and the Trelona part makes up 40 to 60 percent. Included in mapping were small areas of Tassel fine sandy loam, Hargreave fine sandy loam, and Dunday loamy fine sand. Small outcrops of soft sandstone are common.

Runoff is rapid. If this complex is disturbed or the vegetation destroyed, the hazards of water and wind erosion are severe.

This complex is suited to range and wildlife food and cover. The Rosebud soil is suited to windbreaks. (Rosebud part in capability unit VIe–5, dryland; Loamy range site; Sandy windbreak site. Trelona part in capability unit VIIe–14, dryland; Shallow Sandy range site; Unsuitable windbreak site)

Satanta Series

The Satanta series consists of deep, well-drained, nearly level to sloping soils on uplands. These soils are mainly in the central part of the Survey Area but are also associated with Rosebud soils in the southwestern part. They formed in wind-laid loam. The native vegetation is blue grama and western wheatgrass.

In a typical profile the surface layer is grayish-brown loam about 5 inches thick. The upper part of the subsoil is grayish-brown light clay loam about 4 inches thick. The middle part is light-brown light clay loam about 23 inches thick. The lower part, which has a high content of lime, is light-brown loam about 12 inches thick. The underlying material is light-brown sandy clay loam that grades to sandy loam.

Permeability is moderate, and the available water capacity is high. These soils are fertile. Cultivation is easy, and crops respond well to good management.

Satanta soils are used for range and for dryland and irrigated crops. They are suited to windbreaks and wildlife habitat.

Typical profile of Satanta loam, 0 to 1 percent slopes, 583 feet east and 143 feet south of the NW. corner of sec. 1, T. 22 N., R. 63 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, granular structure; soft, very friable; noncalcareous; pH 7.8; gradual, smooth boundary.

B21t— 5 to 9 inches, grayish-brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard to hard, very friable; thin, patchy clay films on peds; noncalcareous; pH 7.8; clear, smooth boundary.

B22t—9 to 19 inches, light-brown (7.5YR 6/3) light clay loam, brown (7.5YR 5/3) moist; weak, medium and fine, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable; thin, patchy clay films on peds; calcareous; pH 8.5; gradual, smooth boundary.

B23t—19 to 32 inches, light-brown (7.5YR 6/3) light clay loam, brown (7.5YR 5/3) moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, friable; thin, patchy clay films on peds; calcareous; pH 8.6; gradual, smooth boundary.

B3ca—32 to 44 inches, light-brown (7.5YR 6/3) loam, brown (7.5YR 5/3) moist; weak, medium and coarse, subangular blocky structure; hard, friable; a few thin, patchy clay films on the vertical faces of peds; a weak ca horizon with visible secondary calcium carbonate occurring as concretions, thin seams, and streaks; calcareous; pH 8.8; gradual, smooth boundary.

C1ca—44 to 57 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; massive or very weak, coarse, subangular blocky structure; slightly hard, very friable; a weak ca horizon with visable calcium carbonate occurring as concretions, thin seams, and streaks; calcareous; pH 9.0; gradual, smooth boundary.

IIC2ca—57 to 70 inches, light-brown (7.5YR 6/4) sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; a weak ca horizon with visible secondary calcium carbonate occurring as concretions, thin seams, and streaks; calcareous; pH 9.0.

The texture of the A horizon ranges from loam to fine sandy loam, and the color from grayish brown to dark grayish brown. The B21t horizon ranges from grayish brown to dark grayish brown or dark brown in color, and from clay loam to loam in texture.

Satanta soils are deeper than Rosebud soils. They have more sand in the B2t horizon than Keith soils. They have a darker colored A horizon than Mitchell soils.

Satanta fine sandy loam, 0 to 3 percent slopes (SaA).—This soil occurs on uplands in the central and eastern parts of the Survey Area. It is similar to the soil described as typical of the series except that the surface layer is fine sandy loam. Included in mapping were small areas of Satanta loam and Anselmo fine sandy loam.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion is severe.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife habitat. A few areas are used for range. Pheasants and rabbits are fairly numerous. Habitat for sharp-tailed grouse, antelope, and deer can be developed.

Potatoes, sugar beets, beans, corn, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. The major problems in managing irrigated cropland are even distribution of irrigation water, control of erosion, maintenance of soil structure, and maintenance of organic-matter content and fertility. Manage irrigation water properly, include grasses and legumes in the rotation, utilize crop residue, and apply proper kinds and amounts of fertilizer.

Winter wheat, oats, barley, and rye are the most suitable dryland crops. Corn, grain sorghum, and al-

falfa can be grown but are less suitable than small grains because of the low moisture supply. Lack of moisture is the principal limitation on dryland. Use alternating strips of crops and stubble mulch to conserve moisture and control wind erosion. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Loamy range site; Sandy windbreak site)

Satanta loam, 0 to 1 percent slopes (StA).—This soil occurs on uplands in the central part of the Survey Area. It has the profile described as typical of the Satanta series. Included in mapping were small areas of Ulysses loam, Duroc loam, and Alkali and saline land.

In cultivated areas, runoff is slow and the hazard of erosion is slight.

This soil is suited to irrigated and dryland crops, range, and farmstead windbreaks. It offers food and cover for wildlife.

Corn, beans, sugar beets, potatoes, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. There are few limitations in irrigated areas. To maintain fertility and tilth manage irrigation water properly, utilize crop residue, and apply proper kinds and amounts of fertilizer.

Winter wheat, oats, rye, and barley are well-suited dryland crops. Alfalfa, corn, and sorghum can also be grown. Lack of moisture is the major limitation on dryland. Alternating strips of crops and summer fallow conserves moisture. Pheasants and rabbits are plentiful. Habitat for sharp-tailed grouse, antelope, and deer can be developed. Some areas are used for range. (Capability unit IIIc–2, dryland; I–1, irrigated; Loamy range site; Silty to Clayey windbreak site)

Satanta loam, 1 to 3 percent slopes (StB).—Except for slope, this soil is similar to Satanta loam, 0 to 1 percent slopes. Included in mapping were small areas of Satanta fine sandy loam, Mitchell silt loam, and Alkali and saline land.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion is moderate.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife habitat.

The irrigated crops commonly grown in this area are suitable. Use irrigation runs of moderate length for even distribution of water and control of erosion.

Small grains are suitable dryland crops. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion. (Capability unit IIIe–2, dryland; IIe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Satanta loam, 3 to 6 percent slopes (StC).—This soil is similar to Satanta loam, 0 to 1 percent slopes, except for slope and the depth to lime, which averages about 9 inches. In many cultivated fields the surface layer is mixed with the upper part of the subsoil. A few small areas of light-colored limy material have been exposed by erosion. Included in mapping were small areas of Ulysses loam, Mitchell silt loam, and Anselmo fine sandy loam.

Runoff is medium. In cultivated areas, the hazard of water and wind erosion is moderate.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife habitat.

Alfalfa, alfalfa-grass mixtures, small grains, corn, beans, sugar beets, and potatoes are suitable irrigated crops. For even distribution of water and control of erosion on irrigated land, use runs of moderate length and contour furrows. Bench leveling and sprinkler irrigation are suitable.

Winter wheat, oats, barley, and rye are suitable dryland crops. Lack of moisture is the major limitation. Wind stripcropping and stubble mulching conserve moisture and help control erosion. Terraces help control water erosion. (Capability unit IIIe–2, dryland; IIIe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Satanta loam, 6 to 10 percent slopes (StD).—Included with this soil in mapping were small areas of Mitchell silt loam and a few areas of moderately steep Satanta loam.

Runoff is medium to rapid. In cultivated areas, the hazard of water erosion is severe and the hazard of wind erosion is moderate.

This soil is suited to range, windbreaks, wildlife habitat, close-growing irrigated crops, and dryland crops.

Small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. Use contour ditches and manage irrigation water properly for control of erosion and even distribution of water. Sprinkler irrigation is suitable.

Tame grasses for hay or pasture are well-suited dryland crops. Slope and lack of moisture are the major limitations on dryland. Small grains can be grown if a combination of terraces, contour strips, and stubble mulch is used to conserve moisture and control erosion. (Capability unit IVe–2, dryland; IVe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Shingle Series

The Shingle series consists of shallow, well-drained, nearly level to moderately steep soils on uplands. They occur in the central part of the Survey Area. These soils formed in material that weathered in place from interbedded sandstone and shale. The native vegetation consists of blue grama, needle-and-thread, and threadleaf sedge.

In a typical profile the surface layer is grayish-brown loam about 3 inches thick. The underlying material is light yellowish-brown heavy loam that grades to clay loam. Soft bedrock occurs at a depth of about 12 inches.

Shingle soils are not generally suited to cultivation, because they are shallow and have low available water capacity. Permeability is moderate. Most areas are used for range.

In this Survey Area Shingle soils are mapped only with Anselmo and Mitchell soils.

Typical profile of Shingle loam (7 percent slopes) in an area of range, 330 feet south and 150 feet east of the NW. corner of the southwest quarter of sec. 23, T. 22 N., R. 64 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine and medium, granular structure; slightly hard, friable, sticky; calcareous; pH about 8.0; clear, smooth boundary.

C1—3 to 8 inches, light yellowish-brown (10YR 6/4) heavy loam, yellowish-brown (10YR 5/4) moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; hard, friable, sticky and slightly plastic; common fine pores; calcareous; pH about 8.2; clear, smooth boundary.

C2—8 to 12 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; hard, friable, sticky and slightly plastic; common fine pores; calcareous; pH about 8.2; clear, smooth boundary.

R—12 inches +, soft, calcareous shale.

The texture of the A horizon ranges from fine sandy loam to clay loam, and the color from grayish brown to light brownish gray. The depth to soft shale or sandstone bedrock ranges from 8 to 20 inches.

Shingle soils are finer textured throughout than Tassel soils and have a finer textured C horizon than Epping soils. They are shallower and have a finer textured C horizon than Mitchell and Anselmo soils. When moist, the A horizon is lighter colored than that of Anselmo soils.

Tassel Series

The Tassel series consists of shallow, well-drained, very gently sloping to steep soils on uplands in the western and southern parts of the Survey Area. These soils formed in material that weathered in place from soft, calcareous sandstone. The native vegetation consists of blue grama and threadleaf sedge.

In a typical profile the surface layer is light brownish-gray fine sandy loam about 3 inches thick. It contains a moderate content of lime. The underlying material is light brownish-gray fine sandy loam. Soft, calcareous sandstone occurs at a depth of about 8 inches.

Tassel soils are not generally suited to cultivation because they are shallow and have low available water capacity. Permeability is moderately rapid. They are suited to wildlife habitat. Most areas are used for range.

In this Survey Area Tassel soils are mapped only in complexes with Colby soils and Rock outcrop, and as a component of Rock land.

Typical profile of Tassel fine sandy loam (20 percent slopes) in native range, 50 feet west of a county road and 100 feet south of crest of hill, NE¼SW¼ sec. 10, T. 19 N., R. 64 W.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure; soft, very friable; calcareous; pH about 8.2; clear, smooth boundary.

C—3 to 8 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure to massive; soft to slightly hard, very friable; calcareous; pH about 8.2; clear, wavy boundary.

R—8 inches +, soft, calcareous sandstone.

The color of the A horizon ranges from light brownish gray to grayish brown. The color of the C horizon ranges from light brownish gray to pale brown. The depth to bedrock ranges from 6 to 20 inches.

Tassel soils differ from Trelona soils in having a lighter colored A horizon and in having lime throughout the profile. They are shallower and coarser textured than Colby soils.

Trelona Series

The Trelona series consists of shallow, well-drained, very gently sloping to steep soils on uplands in the western and southern parts of the Survey Area. These soils formed in material that weathered in place from soft, noncalcareous sandstone. The native vegetation consists of blue grama, needle-and-thread, and threadleaf sedge.

In a typical profile the surface layer is grayish-brown fine sandy loam about 12 inches thick. The underlying material is soft, noncalcareous sandstone.

Trelona soils are shallow and low in available water capacity and are not generally suited to cultivation. Permeability is moderately rapid.

Most areas are used for range. Wildlife habitat can be developed.

In this Survey Area Trelona soils are mapped only with Anselmo, Dunday, and Rosebud soils.

Typical profile of Trelona fine sandy loam (4 percent slopes), in native range, 210 feet east and 312 feet north of the SW. corner of sec. 5, T. 21 N., R. 64 W.:

A11—0 to 2 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; noncalcareous; pH about 7.2; clear, smooth boundary.

A12—2 to 12 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; very weak, medium, subangular blocky structure breaking to weak, fine, crumb; soft to slightly hard, very friable; the lowermost 3 inches of this horizon contains few to common, fine sandstone fragments; noncalcareous; pH about 7.2; clear, wavy boundary.

R—12 inches +, soft, noncalcareous sandstone.

The color of the A horizon ranges from grayish brown to dark grayish brown, and the texture from fine sandy loam to loamy fine sand. The depth to bedrock ranges from 8 to 20 inches.

Trelona soils differ from Tassel soils in having a darker colored A horizon and in lacking lime in the profile. They are shallower than Creighton, Rosebud, and Hargreave soils. They lack the B2t horizon of Rosebud and Hargreave soils.

Ulysses Series

The Ulysses series consists of deep, well-drained, nearly level to gently sloping soils on uplands in the central and eastern parts of the Survey Area. These soils formed in wind-laid silt. The native vegetation is blue grama and needle-and-thread.

In a typical profile the surface layer is grayish-brown loam about 14 inches thick. The subsoil is light brownish-gray loam about 16 inches thick. It has a moderate to high content of lime. The underlying material is light-gray loam that has a high content of lime.

These soils are naturally fertile. Permeability is moderate, and the available water capacity is high. Cultivation is easy.

Ulysses soils are used for dryland and irrigated crops, range, and windbreaks. They are suitable for

wildlife food and cover. Crops respond well to good management.

Typical profile of Ulysses loam, 1 to 3 percent slopes, in an area of native range, 1,200 feet east and 500 feet south of the west quarter corner of sec. 12, T. 22 N., R 61 W.:

A11—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure breaking to moderate to strong, fine, granular; slightly hard, very friable; noncalcareous; pH 7.8; gradual, smooth boundary.

A12—7 to 14 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; slightly hard, very friable; noncalcareous; pH 7.8; gradual, smooth boundary.

B2—14 to 26 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard, very friable; a few thin, patchy clay films on vertical faces of peds; the clay content of this horizon is approximately the same as that of the overlying horizon; calcareous; pH 8.4; gradual, wavy boundary.

B3ca—26 to 30 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; hard, very friable; a weak ca horizon with visible calcium carbonate occurring as concretions, thin seams, and streaks; calcareous; pH 8.4; gradual, wavy boundary.

Cca—30 to 60 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; a weak ca horizon with visible calcium carbonate occurring as concretions, thin seams, and streaks; calcareous; pH 8.4.

The color of the A horizon ranges from grayish brown to dark grayish brown. The color of the B horizon ranges from light brownish gray to pale brown.

Ulysses soils have a thinner A horizon than Duroc soils. They have less clay in the B horizon than Keith soils.

Ulysses loam, 0 to 1 percent slopes (UlA).—This soil occurs on nearly level uplands in the central and eastern parts of the Survey Area. Except for slope, it has the profile described as typical of the series. Included in mapping were small areas of Duroc loam, Goshen-Kuma loams, and Keith loam.

Runoff is slow, and the hazard of erosion is slight.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife food and cover. Pheasants and rabbits are the principal game species. Habitat for sharp-tailed grouse, antelope, and deer can be developed.

Corn, beans, sugar beets (fig. 11), potatoes, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. There are few limitations if this soil is irrigated. Manage irrigation water properly, utilize crop residue and manure, and apply the right kinds and amounts of fertilizer to maintain fertility, soil structure, and organic-matter content.

Winter wheat, oats, barley, rye, corn, grain sorghum, and alfalfa are suitable dryland crops. Lack of moisture is the major limitation. Use alternating strips of crops and summer fallow to conserve moisture. Native grasses are used for grazing in a few places. (Capability unit IIIc–2, dryland; I–1, irrigated; Loamy range site; Silty to Clayey windbreak site)

Figure 11.—Sugar beets on Ulysses loam, 0 to 1 percent slopes.

Ulysses loam, 1 to 3 percent slopes (UlB).—This soil has the profile described as typical of the series. Included in mapping were small areas of Duroc loam, Keith loam, and Mitchell silt loam.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion is moderate.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife food and cover. The crops commonly grown in this Area are well suited. Use runs of moderate length and good irrigation water management to insure even distribution of water and prevent erosion.

Winter wheat, oats, rye, and barley are the most suitable dryland crops. Corn, grain sorghum, and alfalfa can be grown but are less suitable than small grains because of the low moisture supply. Lack of moisture is the principal limitation. Use wind stripcropping and stubble mulching to conserve moisture and control erosion. (Capability unit IIIe–2, dryland; IIe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Ulysses loam, 3 to 6 percent slopes (UlC).—Except for slope and the depth to lime, which ranges from 8 to 12 inches, this soil is similar to Ulysses loam, 1 to 3 percent slopes. Included in mapping were small areas of Mitchell silt loam, Keith loam, and Anselmo fine sandy loam.

Runoff is medium. The hazard of water and wind erosion is moderate in cultivated areas.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife food and cover.

Alfalfa, alfalfa-grass mixtures, small grains, corn, beans, sugar beets, and potatoes are suitable irrigated crops. When row crops are grown, use irrigation runs of moderate length and contour furrows to control erosion and insure even distribution of water. Bench leveling and sprinkler irrigation are suited.

The use and management requirements on dryland are about the same as those for Ulysses loam, 1 to 3 percent slopes. On long slopes, terraces help in controlling water erosion. (Capability unit IIIe–2, dryland; IIIe–2, irrigated; Loamy range site; Silty to Clayey windbreak site)

Valentine Series

The Valentine series consists of deep, excessively drained, nearly level to steep soils on uplands. These soils are mainly in the northeastern part of the Survey Area. They formed in wind-laid sands. The native vegetation consists of prairie sandreed, needle-and-thread, sand bluestem, and sand sagebrush.

In a typical profile the surface layer is brown fine sand about 3 inches thick. The underlying material is pale-brown fine and medium sand.

Permeability is rapid, and the available water capacity is low.

These soils are well suited to range and to wildlife food and cover. They generally are not suited to cultivation.

In this Survey Area Valentine soils are mapped only with Dwyer soils.

Typical profile of Valentine fine sand (17 percent slopes) in ungrazed native vegetation, 70 feet north of Sheep Creek Road on north slope of hill near SW. corner of sec. 5, T. 24 N., R. 60 W.:

A1—0 to 3 inches, brown (10YR 5/3) fine sand, dark brown (10YR 3/3) moist; single grain; loose, very friable to loose; noncalcareous; pH about 7.0; clear, smooth boundary.

C—3 to 60 inches +, pale-brown (10YR 6/3) fine and medium sand, dark brown (10YR 4/3) moist; single grain; soft to loose; very friable to loose; noncalcareous; pH about 7.0.

The texture of the A horizon ranges from fine sand to loamy fine sand, and the color from brown or grayish brown to pale brown or light brownish gray. The color of the C horizon ranges from pale brown or light brownish gray to very pale brown or light gray. In places lime occurs at a depth below 30 inches.

Valentine soils differ from Dwyer soils by lacking lime in the upper 30 inches. They have a lighter colored and thinner A horizon than Dunday soils.

Valentine and Dwyer fine sands, hilly (Vh).—This unit occurs on sandhills, mainly in the northeastern part of the Survey Area. Some areas consist of Valentine fine sand, some of Dwyer fine sand, and some partly of each. Each soil has the profile described as typical of the respective series. Included in mapping were small areas of Valentine and Dwyer fine sands, rolling.

In disturbed areas or areas where the vegetation has been destroyed, the hazard of wind erosion is very severe.

This unit is suited to range and wildlife food and cover. Establishing windbreaks is very difficult. Nearly all the acreage is suited for range. Range areas in good to excellent condition provide habitat for sharp-tailed grouse and antelope. (Capability unit VIIe–15, dryland; Choppy Sands range site; Unsuitable windbreak site)

Valentine and Dwyer fine sands, rolling (Vr).—This unit occurs on uplands, mainly in the northeastern part of the Survey Area. Some areas consist of Valentine fine sand, some of Dwyer fine sand, and some partly of each. Each soil has the profile described as typical of the respective series. Included in mapping were small areas of Valentine loamy fine sand, Dwyer loamy fine sand, and Dunday loamy fine sand.

The hazard of wind erosion is very severe in plowed or otherwise disturbed areas.

This unit is suited to range, windbreaks, wildlife food and cover, and irrigated hay or pasture.

Native grasses are used for grazing in most areas. Range in good to excellent condition furnishes good habitat for sharp-tailed grouse and antelope. Windbreaks are very difficult to establish unless irrigation water is available.

Rapid permeability and low available water capacity are the major limitations. Slope is a limitation in some areas that are used for irrigated hay or pasture. Manage irrigation water properly to insure even distribution of water and to control erosion. Use the right kinds and amounts of fertilizer. (Capability unit VIe–15, dryland; VIs–15, irrigated; Sands range site; Very Sandy windbreak site)

Vetal Series

The Vetal series consists of deep, well-drained, nearly level to gently sloping soils on stream terraces, in upland swales, and in shallow drainageways. These soils occur mainly in the eastern part of the Survey Area. They formed in water-laid sands. The native vegetation is blue grama and needle-and-thread.

In a typical profile the surface layer is grayish-brown fine sandy loam about 40 inches thick. The underlying material is grayish-brown fine sandy loam that has a high content of lime.

Permeability is moderately rapid, the available water capacity is moderate, and natural fertility is medium. Cultivation is easy.

Vetal soils are used for dryland and irrigated crops, range, and windbreaks. They are suited to wildlife food and cover. Crops respond to good management.

Typical profile of Vetal fine sandy loam, 0 to 4 percent slopes, in a cultivated field, 600 feet south and 75 feet east of the NW. corner of SW¼NE¼ sec. 8, T. 21 N., R. 60 W.:

A11—0 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; very weak, medium, subangular blocky structure breaking to moderate, very fine, granular; soft, very friable; noncalcareous; pH 7.4; clear, smooth boundary.

A12—6 to 40 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak to moderate, coarse, subangular blocky structure breaking to fine granular; slightly hard, very friable; noncalcareous; pH 7.6; gradual, wavy boundary.

Cca—40 to 60 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; a very weak ca horizon with some visible calcium carbonate occurring as small threadlike seams; calcareous; pH 8.3.

The color of the A horizon ranges from grayish brown to dark grayish brown or dark brown. The texture of the A11 horizon ranges from fine sandy loam to loamy fine sand. The color of the A12 horizon ranges from grayish brown to light brownish gray.

Vetal soils have a thicker A horizon than Anselmo and Bayard soils. They have a thicker A horizon than Manter and Ascalon soils, but lack the B2t horizon that is typical of those soils. In contrast with Hawksprings soils, they are not underlain by loose sand and gravel.

Vetal fine sandy loam, 0 to 4 percent slopes (VtB).—This soil occurs on stream terraces along Horse Creek and the North Platte River, and in upland swales and shallow drainageways, mainly in the eastern part of the Survey Area. It has the profile described as typical of the series. Included in mapping were small areas of Anselmo fine sandy loam, Bayard fine sandy loam, and Hawksprings fine sandy loam.

Runoff is slow. In cultivated areas, the hazard of water erosion is slight and the hazard of wind erosion is severe.

This soil is suited to irrigated and dryland crops, range, windbreaks, and wildlife food and cover. Native grasses are used for grazing in a few places. Pheasants and rabbits are the principal game species. Habitat for sharp-tailed grouse, deer, and antelope can be developed.

Potatoes, corn, sugar beets, beans, small grains, alfalfa, and alfalfa-grass mixtures are suitable irrigated crops. The principal limitation is moderate available water capacity. Manage irrigation water properly, utilize crop residue and manure, and apply the right kinds and amounts of fertilizer to maintain fertility, soil structure, and organic-matter content, and to control erosion.

Winter wheat, oats, rye, and barley are well-suited dryland crops. Alfalfa, corn, and grain sorghum can be grown but are less suitable than small grains because of the low moisture supply. Lack of moisture is the major limitation. Use wind stripcropping and stubble mulching to conserve moisture and control wind erosion. (Capability unit IIIe–5, dryland; IIe–5, irrigated; Sandy range site; Sandy windbreak site)

Weld Series

The Weld series consists of deep, well-drained, nearly level to sloping soils on the tablelands in the western and southwestern parts of the Survey Area. These soils formed in wind-laid silt. The native vegetation consists of blue grama, buffalograss, and needle-and-thread.

In a typical profile the surface layer is grayish-brown loam about 4 inches thick. The upper part of the subsoil is brown heavy clay loam that grades to pale-brown heavy clay loam about 12 inches thick. The lower part of the subsoil is white light clay loam that has a high content of lime and is about 10 inches thick. The underlying material is white loam that has a high content of lime.

Permeability is moderate, and the available water capacity is high. Cultivation is easy. The soils are naturally fertile and respond to management.

Weld soils are used for range, dryland crops, and windbreaks. They are suitable for development as wildlife habitat.

In this Survey Area Weld soils are mapped only with Norka soils.

Typical profile of Weld loam (less than 1 percent slopes) in an area of native range, near the NW. corner of the SW¼SW¼ of sec. 25, T. 25 N., R. 64 W.:

A1—0 to 4 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, granular structure; soft, very friable; there is some gray coating in the lower part of this horizon; noncalcareous; pH 7.2; abrupt, smooth boundary.

B21t—4 to 10 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 3/3) moist; strong, fine, prismatic structure breaking to strong, fine, angular blocky; very hard, friable; moderate, continuous clay films on peds; noncalcareous; pH 7.4; clear, smooth boundary.

B22t—10 to 16 inches, pale-brown (10YR 6/3) heavy clay loam, dark brown (10YR 4/3) moist; strong, fine, prismatic structure breaking to strong, fine, angular blocky; very hard, friable; thick, continuous clay films on peds; noncalcareous; clear, smooth boundary.

B3ca—16 to 26 inches, white (2.5Y 8/2) light clay loam, grayish brown (2.5Y 5/2) moist; moderate, medium, subangular blocky structure; hard, friable; few, thin, patchy clay films on peds; strong ca horizon of calcium carbonate accumulation with visible lime occurring in divided forms and as small concretions; strongly calcareous; gradual, smooth boundary.

Cca—26 to 60 inches, white (2.5Y 8/2) loam, light yellowish brown (2.5Y 6/3) moist; massive or very weak, coarse, subangular blocky structure; slightly hard, very friable; strong ca horizon of lime accumulation with visible lime occurring in divided forms and as concretions; strongly calcareous.

The color of the A horizon ranges from grayish brown to dark grayish brown. The color of the B21t and B22t horizons ranges from brown and pale brown to dark brown or dark grayish brown. The texture of the B3ca horizon ranges

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from clay loam to loam, and the color from white to light gray. The color of the Cca horizon ranges from white to pale brown.

Weld soils have a stronger structural development than Norka soils and more clay in the B2t horizon. They have a thinner A horizon than Goshen soils and more clay in the B2t horizon.

Use and Management of the Soils

This section discusses the use and management of the soils of the southern part of Goshen County for crops, range, windbreaks, wildlife habitat, and engineering.

Management of the Soils for Crops

This section discusses the capability classification system used by the Soil Conservation Service and its application in this Survey Area. It also discusses management of dry cropland soils and management of irrigated soils. In addition, this section contains a brief discussion of predicted yields and a table showing yields of the major crops that can be expected under two levels of management.

Both dryland farming and irrigated farming are practiced in Goshen County, and each capability unit is designated as either dryland or irrigated. Soils that are farmed partly as dryland and partly under irrigation are in two capability units. Duroc loam, 1 to 3 percent slopes, for example, is in capability unit IIIe–2, dryland and IIe–2, irrigated. The capability classification of each soil mapped in the county can be learned by referring to the "Guide to Mapping Units." Information about management is given in the section "Descriptions of the Soils."

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and genally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.
- Irrigated unit I–1. Deep, well-drained, medium-textured, nearly level soils on uplands, in upland swales, and on flood plains.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if they are cultivated and not protected.
  - Irrigated unit IIe–2. Deep, well-drained, medium-textured, very gently sloping soils on uplands, in upland swales, and in shallow drainageways.
  - Irrigated unit IIe–3. Deep and moderately deep, well-drained, medium-textured, nearly level to very gently sloping soils on uplands, fans, and foot slopes.
  - Irrigated unit IIe–5. Deep, well-drained, moderately coarse textured, nearly level to very gently sloping soils on uplands, foot slopes, terraces, and flood plains.
- Subclass IIs. Soils that have moderate limitations because of moderate available water capacity.
  - Irrigated unit IIs–2. Moderately deep, well-drained, medium-textured, level to very gently sloping soils underlain by loose sand and gravel at a depth of 20 to 40 inches.
- Subclass IIc. Soils that have slight climatic limitations for use and management.
  - Dryland unit IIc—46. Deep, well-drained, medium-textured, moderately permeable, nearly level soils in upland swales and shallow drainageways.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.
  - Dryland unit IIIe–2. Deep and moderately deep, well-drained, medium-textured, nearly level to gently sloping soils on uplands, in swales, and in shallow drainageways.
  - Dryland unit IIIe–5. Deep and moderately deep, well-drained, moderately coarse textured, nearly level to gently sloping soils on uplands, fans, foot slopes, and flood plains.
  - Irrigated unit IIIe–1. Deep, well-drained, moderately fine textured, very gently sloping soils on fans and foot slopes.
  - Irrigated unit IIIe–2. Deep, well-drained, medium-textured, gently sloping soils on uplands.
  - Irrigated unit IIIe–3. Deep and moderately deep, well-drained, medium-textured, gently sloping soils on uplands, fans, and foot slopes.

Irrigated unit IIIe–4. Deep, excessively drained, coarse-textured, nearly level to very gently sloping soils on uplands, fans, and flood plains.

Subclass IIIs. Soils that have limitations because of texture.

Irrigated unit IIIs–1. Deep, well-drained, moderately fine textured, nearly level soils on fans and valley side slopes.

Subclass IIIw. Soils that have limitations because of frequent flooding or that have a fluctuating water table.

Irrigated unit IIIw–63. Predominantly deep, somewhat poorly drained, nearly level to gently sloping soils on flood plains and in upland depressions.

Subclass IIIc. Soils that have moderate climatic limitations.

Dryland unit IIIc–2. Deep and moderately deep, well-drained, medium-textured, nearly level soils on uplands and flood plains.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to severe erosion if they are cultivated and not protected.

Dryland unit IVe–1. Deep, well-drained, moderately fine textured, very gently sloping to sloping soils on fans and foot slopes.

Dryland unit IVe–2. Deep and moderately deep, well-drained, medium-textured, sloping soils on uplands.

Dryland unit IVe–3. Deep and moderately deep, well-drained, medium-textured, nearly level to sloping soils on uplands, fans, and foot slopes.

Dryland unit IVe–4. Deep, excessively drained, nearly level to very gently sloping soils on uplands, fans, and flood plains.

Dryland unit IVe–5. Deep and moderately deep, well-drained, moderately coarse textured, nearly level to sloping soils on uplands, fans, terraces, and flood plains.

Irrigated unit IVe–1. Deep, well-drained, moderately fine textured, gently sloping to sloping soils on fans and foot slopes.

Irrigated unit IVe–2. Deep, well-drained, medium-textured, sloping soils on uplands.

Irrigated unit IVe–3. Deep, well-drained, medium-textured, sloping soils on uplands and fans.

Irrigated unit IVe–4. Deep, excessively drained, coarse-textured, gently sloping to sloping soils on uplands, fans, foot slopes, and flood plains.

Irrigated unit IVe–5. Deep and moderately deep, well-drained, moderately coarse textured, sloping soils on uplands, fans, and foot slopes.

Irrigated unit IVe–14. Shallow, well-drained, medium-textured, nearly level to gently sloping soils on uplands.

Subclass IVw. Soils that are frequently flooded or that have a fluctuating water table.

Dryland unit IVw–63. Predominantly deep, somewhat poorly drained, nearly level to gently sloping soils on flood plains and in upland depressions.

Subclass IVs. Soils that have limitations because of texture.

Dryland unit IVs–1. Deep, well-drained, fine textured to moderately fine textured, nearly level soils on fans and valley side slopes.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. (None in this Survey Area.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, woodland, or wildlife habitat.

Subclass VIe. Soils subject to severe erosion unless properly managed.

Dryland unit VIe–3. Deep, well-drained, medium-textured soils that have a high content of lime.

Dryland unit VIe–4. Deep, excessively drained, coarse-textured, gently sloping to steep soils on uplands, fans, foot slopes, and flood plains.

Dryland unit VIe–5. Deep and moderately deep, well-drained, moderately coarse textured, sloping to moderately steep soils on uplands, fans, and foot slopes.

Dryland unit VIe–6. Well-drained to excessively drained, gently sloping to sloping, gravelly and very gravelly soils on high terraces.

Dryland unit VIe–14. Shallow, well-drained, medium-textured, very gently sloping to sloping soils on uplands.

Dryland unit VIe–15. Deep, excessively drained, coarse-textured, nearly level to moderately steep soils on uplands.

Irrigated unit VIe–3. Deep, well-drained, medium-textured, moderately steep soils on uplands and foot slopes.

Irrigated unit VIe–5. Deep and moderately deep, well-drained, moderately coarse textured, moderately steep soils on uplands and foot slopes.

Irrigated unit VIe–14. Shallow, well-drained, medium-textured, sloping to moderately steep soils on uplands.

Subclass VIs. Soils that have severe limitations because of low available moisture capacity, alkali or soluble salts, or shallow rooting zone.

Dryland unit VIs–14. Shallow, well-drained, fine-textured, nearly level to very gently sloping, strongly alkaline soils on upland flats and in basins.

Irrigated unit VIs–14. Shallow, well-drained, fine-textured, nearly level to very gently sloping, strongly alkaline soils on upland flats and in basins.

Irrigated unit VIs–15. Deep, excessively drained, coarse-textured, gently sloping to moderately steep soils on uplands.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Dryland unit VIws–10. Deep soils that have alkali or soluble salts in all or part of the profile.

Irrigated unit VIws–10. Deep, nearly level to gently sloping soils that have alkali or soluble salts in all or part of the profile; on flood plains, terraces, and foot slopes, and in upland swales.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Subclass VIIe. Soils subject to severe erosion unless properly managed.

Dryland unit VIIe–6. Well-drained to excessively drained, moderately steep to steep, gravelly and very gravelly soils on high terrace rims.

Dryland unit VIIe–14. Shallow, well-drained, moderately coarse textured, moderately steep to steep soils on uplands; shallow, well-drained, medium-textured and fine-textured, gently sloping to moderately steep soils on uplands.

Dryland unit VIIe–15. Deep, excessively drained, coarse-textured, steep soils on uplands.

Dryland unit VIIe–82. Gullied land.

Subclass VIIs. Soils that have severe limitations because of a shallow rooting zone.

Irrigated unit VIIs–6. Nearly level alluvial sands and gravel on flood plains.

Class VIII soils and land forms have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

Subclass VIIIe. Soils and land forms that have limitations because of erosion.

Dryland unit VIIIe–15. Deep, loose, barren sands on shifting dunes.

Subclass VIIIs. Land forms that consist of bedrock.

Dryland unit VIIIs–83. Soft, barren, gently sloping shales and siltstones and barren sandstone outcrops.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIe–5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass. In this Survey Area the capability units are numbered within a system of capability classification that is used throughout the State. Not all the capability units in this system are applicable, and for this reason the numbering of the capability units is not consecutive in all cases.

Management of the soils for dry cropland [3]

Most of the Survey Area was rolling grassland before 1880, when the first homestead entry was made. Small grains have been the major dryland crop. Some corn and sorghum have been grown, but shortage of summer moisture limits production. Winter wheat is the most common crop. Grasses are well suited. Alfalfa does well on a few soils.

Wind erosion became a problem soon after farming began. It reached a peak during the drought of the 1930's. A system of wind stripcropping was begun then and continues to the present time. Wind erosion can be effectively controlled on some soils with wind stripcropping, but other soils need additional protection by keeping crop residue on the surface and by surface ridging.

Water erosion is a moderate to severe hazard on some of the soils. The practices used to control wind erosion may only partly control water erosion. Often, additional amounts of residue kept on the surface give

[3] By R. L. TRESLER, conservation agronomist, Soil Conservation Service.

adequate control. Terraces and contour stripcropping may be needed in addition to stubble mulching on the steeper, longer slopes. Diversion ditches and grassed waterways are used to dispose of excess water safely.

Maintenance of fertility in not generally a problem with the wheat-fallow system of farming. Moisture is the factor that limits crop production in most dryland soils, but adequate fertility elements are usually present that enable wheat to use the available moisture. No general fertilizer recommendations are made for dryland soils. Use of some fertilizer may be economical on soils that have a water table within the reach of plant roots or that receive run-in moisture. Grass responds to nitrogen. Soils should be tested and the latest recommendations checked before applying fertilizer.

There is generally no advantage to using legumes or other crops for green manure in a dryland cropping system. Yields are often lowered because the green-manure crop depletes moisture. The use of grasses and legumes in rotation with wheat and fallow is of limited value. The establishment of grass and legumes is difficult, and the stands are undependable. Hay and pasture seedings are done on a permanent basis.

Moisture conservation is a continuing need on dryland soils. The normal precipitation has to be used as efficiently as possible to obtain satisfactory production. The most widely used cropping system for dryland grain is alternating crops with fallow. Crop residue maintained on the surface helps to increase water intake and decrease wind and water erosion.

Compaction from tillage can be a problem on some soils. Varying the depth of tillage and avoiding tillage when soils are wet help prevent tillage pans or compacted layers.

Management of the soils for irrigated cropland

In most years natural moisture is adequate for plant needs in spring. Irrigation is usually begun near the end of June. The water supply is limited in most systems, and careful use of available water is necessary. The major irrigated crops are sugar beets, beans, corn for grain or silage, potatoes, small grains, and alfalfa and grass for hay or pasture.

The three major considerations in management of irrigated soils in the Survey Area are erosion control, maintenance of soil structure, and maintenance of fertility.

The irrigated soils are subject to wind and water erosion unless they are carefully managed. Wind erosion is most prevalent on sandy soils left bare by row crops that produce little or no residue. A protective cover of small grains can be established if seeding is done early and moisture and fertility requirements are met. Rough tillage is often used successfully to control wind erosion on bare land. Maximum use of crop residue is needed to protect the soils in winter. Alternating row crops with crops that produce high residue also reduces the hazard of wind erosion.

Careful use of irrigation water will control erosion from applied water, but there is a hazard of water erosion from natural rainfall on sloping irrigated areas. Furrow irrigation on slopes where the furrow gradient exceeds 2 percent is impractical because runoff from natural rainfall carries away soil material. The slope gradient can be reduced by bench leveling and by farming across the slope or in a contour furrow system. A ditch and underground pipe system sometimes creates a serious erosion problem, but surface interception ditches can be installed to divert runoff.

Maintenance of soil structure is necessary to provide (1) adequate soil aeration, (2) desirable water intake rate, and (3) good soil tilth. Tillage should not be done when the soil moisture content is high. Using a grass-legume mixture in the rotation is the most common method of maintaining soil structure. Applying barnyard manure and plowing under crop residue add needed organic material. Burning of crop residue destroys organic matter and leads to wind erosion, loss of fertility, and poor tilth.

Maintenance of soil fertility is a continuing need. Nitrogen is the plant nutrient most needed by most crops. Phosphate is usually needed for such crops as sugar beets and alfalfa. Some zinc deficiencies have been noted in the Area. Soil testing services are available through the Wyoming State Extension Service of the University of Wyoming.

A soil suitable for irrigated crops has medium texture, good structure, and adequate depth for moisture storage. It has good available water capacity and a moderate water intake rate. It is free of excessive salts and alkali. A high water table is not a problem.

Some of the limitations that affect the soils of the Survey Area are discussed in the following paragraphs.

Alkalinity.—This condition is caused by an excessive amount of exchangeable sodium in the soil. It causes deterioration of structure, a low water intake rate, poor tilth, and poor aeration. Where the substratum is such that drainage is favorable, gypsum can be applied and the soil reclaimed by leaching. Where subdrainage is poor, the best alternative is to grow tolerant crops.

Salinity.—This condition is caused by an excessive amount of soluble salts and is usually associated with a high water table. The salts interfere with plant growth by making intake of water more difficult. Reclamation may be accomplished by drainage and leaching if substrata conditions permit. If drainage is not possible, salt-tolerant crops can be grown.

Soil depth.—More than 36 inches of soil is desirable for irrigated crops. Soils less than 36 inches deep require more frequent irrigation, have less room for root development, and are less productive.

Soil slope.—The preferred soil for irrigation is nearly level. A slope of more than 2 percent, unless contoured, should be restricted to close-growing crops because of the erosion hazard. A grass-legume mixture on slopes of more than 2 percent should include a sod-forming grass. Where the slope is more than 9 percent, at least half of the mixture should be sod-forming grass. Where the slope is more than 15 percent, the soils are unsuitable for irrigation.

A water table in this Area is usually associated with varying degrees of salinity and is generally detrimental to crops. This condition is caused by overirrigation and by water moving from ditches, from higher lying soils, and from ponded surface water. Reclamation can be accomplished by drainage if subsurface conditions are

favorable. If reclamation is not possible, tolerant crops may be grown.

Areas of sandy soils present a severe hazard of wind erosion, and a conservation cropping system that provides protection must be used. Very sandy soils have a very rapid rate of water intake and low available water capacity. They require frequent application of water to maintain moisture for normal plant growth, and careful application to prevent loss beyond the root zone.

Clay soils require special treatment because of their poor tilth and very slow rate of water intake. Tillage must be done when the moisture content is neither too low nor too high. The incorporation of organic matter is important to maintain tilth and structure.

Successful irrigated farming depends on proper use of water. The objective of irrigation is to keep enough moisture in the soil at all times for normal plant growth. The soil is a reservoir that holds a certain amount of water. Plants remove this water, and then the reservoir needs to be replenished. Water that penetrates beyond the reach of plants roots is lost to the crop, and it also leaches out soluble plant nutrients.

Irrigation guides that are helpful in planning irrigation systems have been prepared by the Soil Conservation Service and cooperating agencies. This information is available at local offices of the Soil Conservation Service.

Predicted yields

The predicted average yields per acre for the principal crops grown in the Survey Area are given in table 2. These yields are given for two levels of management. The predictions in columns A can be expected under an average level of management, and those in columns B, under a high level of management.

The following practices are assumed to be part of an average level of management for dryland crops:

1. Wind stripcropping.
2. Alternating crops with summer fallow.

The following practices are assumed to be part of a high level of management for dryland crops:

1. Wind stripcropping.
2. Alternating crops with summer fallow.
3. Stubble mulching.
4. Emergency tillage as needed.
5. Chiseling as needed.
6. Terracing on moderately fine textured and medium-textured soils on long slopes.
7. Contour stripcropping where necessary.
8. Timely management of seeding, tillage, and harvesting operations.
9. Controlling weeds, disease, and insects as needed.
10. Using high-quality seed.

For irrigated crops, the following practices are assumed to be part of an average level of management:

1. Ordinary management of irrigation water.
2. Minimum use of fertilizer and manure.
3. Crop rotation for insect and disease control only.
4. Emergency tillage on acreage used for beans.

The following practices are assumed to be part of a high level of management for irrigated crops:

1. Improved management of irrigation water.
2. Use of conservation cropping systems.
3. Use of fertilizer, amendments, and manure in amounts needed by the crop to be grown and as indicated by the results of soil tests.
4. Control of weeds, insects, and disease.
5. Emergency tillage as needed.
6. Annual renovation of old alfalfa stands.
7. Timely completion of all management operations.

The yield predictions in table 2 are based on normal growing conditions for the Area. Damage from frost, hail, drought, insect infestations, and floods was not considered. The estimates reflect the inherent differences in soils and their response to management. They were based on data obtained from farmers, the Wyoming Agricultural Experiment Station, the County Agricultural Agent, officials of irrigation districts, fertilizer dealers, and personnel of the Soil Conservation Service.

Management of the Soils for Range [4]

Approximately 67 percent of the Survey Area is used for native range. Most of the ranches are cow-calf operations. The calves and some yearling steers and heifers are sold in the fall. There are only a few sheep ranches.

Successful management of range depends on the proper degree of utilization, the proper distribution of livestock, and the proper season of use.

Range is properly utilized when approximately half the foliage is left at the end of the growing season. This means that only half of the herbage of the key forage species can be safely grazed during the growing season. This kind of utilization allows the plants to store enough food to maintain vigor and successfully compete with other plants. It also provides a mulch that aids in water intake, moisture storage, and control of erosion. The latter is especially important on Sands, Choppy Sands, and Sandy range sites, which have a severe wind erosion hazard if the plant cover becomes too sparse. Another important function of this residue is to provide a food reserve during short-term droughts.

It is difficult to control grazing in large pastures where there are inclusions of several different range sites and a minimum of watering places. Range sites, such as Sands and Choppy Sands, that have tall-grass vegetation are often overgrazed when included in a pasture with other range sites.

Even distribution of livestock can be encouraged by supplying a sufficient number of well-located water places and by placing salt and supplies of mineral supplements away from watering places in lightly grazed areas.

Grazing can also be controlled by fencing. Fencing between different range sites, where the kinds of veg-

[4] By A. P. THATCHER, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average yields per acre under two levels of management*

[Yields in columns A can be expected under an average level of management; those in columns B can be expected unde management. Dashes indicate the crop is not suited to the soil or is grown in very small amounts]

Soil	Irrigated crops																Dryland			
	Alfalfa		Barley		Beans		Beets		Corn for grain		Corn for silage		Oats		Potatoes		Barley		Oats	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	
Alkali and saline land	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Anselmo fine sandy loam, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17	21	19	
Anselmo and Dwyer soils, 0 to 3 percent slopes	2.0	4.0	35	45	25	35	12	17	50	80	12	18	40	60	250	400	14	18	15	
Anselmo and Dwyer soils, 3 to 6 percent slopes	1.5	3.0	30	40	20	30	10	15	35	65	10	15	30	45	175	350	12	15	13	
Anselmo and Dwyer soils, 6 to 10 percent slopes	1.0	2.0	20	35	—	—	—	—	—	—	—	—	20	35	—	—	10	13	11	
Anselmo and Dwyer soils, 10 to 15 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Anselmo and Shingle soils, 0 to 3 percent slopes	2.0	3.5	35	50	20	30	11	15	40	60	10	14	35	55	—	—	14	18	15	
Anselmo and Shingle soils, 3 to 10 percent slopes	1.0	2.0	25	35	—	—	—	—	—	—	—	—	30	45	—	—	10	13	11	
Anselmo and Shingle soils, 10 to 15 per- slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Anselmo-Trelona loamy fine sands, 0 to 3 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	12	10	
Ascalon fine sandy loam, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19	24	21	
Ascalon fine sandy loam, 6 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	18	15	
Badlands	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Bankard loamy fine sand, 0 to 3 percent slopes	1.5	3.0	30	40	20	30	10	15	35	65	8	14	35	50	200	300	9	12	10	
Bankard loamy fine sand, 3 to 6 percent slopes	1.0	2.0	20	35	—	—	—	—	—	—	—	—	30	45	—	—	—	—	—	
Bayard fine sandy loam, 0 to 7 percent slopes	3.0	4.5	45	60	32	40	14	20	70	100	14	20	55	80	300	450	17	21	19	
Bayard and Otero fine sandy loams, 0 to 3 percent slopes	2.5	4.0	40	55	27	36	13	18	65	90	13	18	50	70	250	400	17	21	19	
Bayard and Otero fine sandy loams, 3 to 6 percent slopes	2.0	3.0	35	45	23	32	11	16	55	80	11	15	45	60	200	300	15	19	17	
Bordeaux fine sandy loam, 0 to 3 percent slopes	2.5	4.5	45	60	30	40	14	20	70	100	14	20	50	75	250	450	19	24	21	
Bordeaux fine sandy loam, 3 to 6 percent slopes	2.0	3.5	35	55	25	35	12	17	50	85	11	17	40	60	200	350	16	20	18	
Bordeaux fine sandy loam, 6 to 10 percent slopes	1.5	2.5	25	40	—	—	—	—	—	—	—	—	30	40	—	—	13	16	14	
Chappell and Hawksprings fine sandy loams, 0 to 6 percent slopes	2.0	3.0	35	45	24	35	14	18	55	80	11	15	40	60	200	350	15	19	17	
Chappell and Hawksprings fine sandy loams, 6 to 10 percent slopes	1.5	2.0	25	35	—	—	—	—	—	—	—	—	30	40	—	—	—	—	—	
Chappell complex, 10 to 15 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Colby loam, 3 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	18	14	
Colby loam, 10 to 20 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Colby-Tassel complex, 2 to 8 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	12	12	

TABLE 2.—*Predicted average yields per acre under two levels of management*—Continue

Soil	Irrigated crops																Dryland			
	Alfalfa		Barley		Beans		Beets		Corn for grain		Corn for silage		Oats		Potatoes		Barley		Oats	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	
Creighton very fine sandy loam, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21	25	22	
Creighton very fine sandy loam, 6 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16	20	17	
Creighton very fine sandy loam, 10 to 20 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Dix complex, 0 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Dix complex, 10 to 40 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Dunday and Dwyer loamy fine sands, 0 to 3 percent slopes	2.0	4.0	30	40	23	33	11	17	45	70	10	15	40	55	250	400	10	13	11	
Dunday and Dwyer loamy fine sands, 3 to 10 percent slopes	1.0	2.5	20	35	—	—	—	—	—	—	—	—	35	50	—	—	—	—	—	
Dunday-Trelona complex, 3 to 35 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Dunday and Vetal loamy fine sands, 0 to 3 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	18	15	
Dunday and Vetal loamy fine sands, 3 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Dune land	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Duroc loam, 0 to 1 percent slopes	3.5	5.0	50	70	35	45	18	22	80	110	16	22	60	90	350	500	30	36	31	
Duroc loam, 1 to 3 percent slopes	3.0	4.5	45	60	30	40	16	20	70	100	14	20	55	80	300	400	26	31	28	
Dwyer loamy fine sand, 0 to 3 percent slopes	1.5	3.0	30	40	22	30	10	14	40	70	8	14	35	50	200	300	9	12	10	
Dwyer loamy fine sand, 3 to 10 percent slopes	1.0	2.0	20	30	—	—	—	—	—	—	—	—	30	40	—	—	—	—	—	
Dwyer and Mitchell soils, 10 to 15 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Epping silt loam, 0 to 6 percent slopes	1.0	2.0	25	35	—	—	—	—	—	—	—	—	30	40	—	—	—	—	—	
Epping silt loam, 6 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Epping silt loam, 10 to 15 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Glenberg fine sandy loam, 0 to 3 percent slopes	2.5	4.0	40	55	27	36	13	18	65	90	13	18	50	70	250	400	16	20	18	
Goshen-Kuma loams, 0 to 2 percent slopes	3.5	5.0	50	70	35	45	18	22	80	110	16	22	60	90	350	500	29	35	31	
Gullied land	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Haverson fine sandy loam, 0 to 3 percent slopes	3.0	4.5	45	60	30	40	14	20	60	100	14	20	55	75	300	450	18	23	20	
Haverson loam, gravel substratum variant, 0 to 3 percent slopes	2.5	4.0	45	60	25	35	15	20	60	90	14	18	55	75	300	450	17	21	19	
Haverson and McCook loams, 0 to 3 percent slopes	3.5	5.0	50	70	35	45	18	22	75	110	16	22	60	90	350	500	24	29	25	
Heldt clay, 0 to 3 percent slopes	3.0	4.5	55	80	24	32	15	20	65	90	13	20	50	75	—	—	22	26	23	
Keith loam, 0 to 1 percent slopes	3.5	5.0	50	70	35	45	18	22	80	110	16	22	60	90	350	500	25	30	26	
Keith loam, 1 to 3 percent slopes	3.0	4.5	45	65	30	40	16	20	70	100	15	20	55	80	280	450	24	29	25	
Keith loam, 3 to 6 percent slopes	2.0	4.0	40	55	25	35	14	18	60	90	12	18	50	70	200	400	21	25	22	
Keota silt loam, 0 to 3 percent slopes	2.5	3.5	35	50	25	35	13	18	55	80	12	16	45	65	—	—	16	19	17	
Keota silt loam, 3 to 6 percent slopes	2.0	3.0	30	40	20	30	11	16	45	70	10	14	40	55	—	—	14	17	14	
Keota-Epping silt loams, 6 to 15 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Kim clay loam, alkali, 0 to 1 percent slopes	3.0	4.0	50	70	24	32	13	18	55	75	12	17	50	75	—	—	18	22	19	
Kim clay loam, alkali, 1 to 3 percent slopes	2.5	3.5	40	60	22	30	12	16	50	70	11	16	45	70	—	—	16	19	17	

Kim clay loam, alkali, 3 to 10 percent slopes	1.5	2.5	30	45	—	—	—	—	—	—	—	—	35	50	—	—	13	16	14	1
Marsh and Wet land, 0 to 5 percent slopes	—	—	30	45	—	—	—	—	—	—	—	—	40	55	—	—	—	—	20	2
Manter and Anselmo fine sandy loams, 0 to 3 percent slopes	2.5	4.5	45	60	30	40	14	20	70	100	14	20	50	75	250	450	19	24	21	2
Manter and Anselmo fine sandy loams, 3 to 6 percent slopes	2.0	3.5	35	55	25	35	12	17	50	85	11	17	40	60	200	350	16	20	18	2
Manter and Anselmo fine sandy loams, 6 to 10 percent slopes	1.5	2.5	25	40	—	—	—	—	—	—	—	—	30	40	—	—	13	16	14	1
Mitchell-Shingle loams, 0 to 3 percent slopes	2.0	3.0	30	40	17	26	12	16	40	55	10	14	40	55	—	—	14	17	14	1
Mitchell-Shingle loams, 3 to 10 percent slopes	1.0	2.0	20	30	—	—	—	—	—	—	—	—	30	40	—	—	13	16	13	1
Mitchell silt loam, 0 to 3 percent slopes	2.5	4.0	45	60	25	35	14	19	65	100	15	20	50	75	—	—	18	22	19	2
Mitchell silt loam, 3 to 6 percent slopes	2.0	3.0	35	50	22	30	13	17	55	80	12	16	45	65	—	—	15	18	16	1
Mitchell silt loam, 6 to 10 percent slopes	1.5	2.0	30	45	—	—	—	—	—	—	—	—	35	50	—	—	13	16	13	1
Mitchell silt loam, 10 to 15 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Mixed alluvial land	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Norka loam, 0 to 1 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26	31	28	3
Norka loam, 1 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	22	26	23	2
Norka and Colby loams, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20	24	21	2
Norka-Weld loams, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24	29	25	3
Norka-Weld loams, 6 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17	20	18	2
Orella clay, 0 to 3 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Orella and Epping soils, 3 to 15 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Otero fine sandy loam, 0 to 3 percent slopes	2.5	4.0	40	55	25	36	13	18	55	85	12	17	45	70	200	350	16	20	18	2
Otero fine sandy loam, 3 to 6 percent slopes	2.0	3.5	35	50	21	30	11	15	45	80	11	15	35	55	175	300	14	18	15	1
Otero fine sandy loam, 6 to 10 percent slopes	1.5	3.0	25	40	—	—	—	—	—	—	—	—	28	40	—	—	—	—	—	-
Rock land	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Rock outcrop-Tassel complex	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Rosebud-Dunday-Trelona loamy fine sands, 0 to 3 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	12	10	1
Rosebud-Dunday-Trelona loamy fine sands, 3 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Rosebud and Hargreave fine sandy loams, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17	21	19	2
Rosebud and Hargreave fine sandy loams, 6 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12	15	13	1
Rosebud and Norka loams, 0 to 1 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24	29	25	3
Rosebud and Norka loams, 1 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20	24	21	2
Rosebud and Norka loams, 6 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16	19	17	2
Rosebud and Satanta loams, 0 to 3 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23	28	24	2
Rosebud-Trelona complex, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	17	15	1
Rosebud-Trelona fine sandy loams, 0 to 6 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	14	12	1
Rosebud-Trelona fine sandy loams, 6 to 10 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9	11	10	1
Rosebud-Trelona fine sandy loams, 10 to 20 percent slopes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Satanta fine sandy loam, 0 to 3 percent slopes	3.0	4.5	45	65	28	40	16	20	60	100	15	20	50	80	300	500	20	25	22	2
Satanta loam, 0 to 1 percent slopes	3.5	5.0	50	70	35	45	17	22	80	110	16	22	60	90	350	500	26	31	28	3
Satanta loam, 1 to 3 percent slopes	3.0	4.5	45	65	30	40	15	20	70	100	15	20	55	80	280	450	24	29	25	3
Satanta loam, 3 to 6 percent slopes	2.0	4.0	40	55	25	35	13	18	60	90	12	18	50	70	200	400	21	25	22	2
Satanta loam, 6 to 10 percent slopes	1.5	3.0	30	45	—	—	—	—	—	—	—	—	35	50	—	—	17	20	18	2
Ulysses loam, 0 to 1 percent slopes	3.5	5.0	50	70	35	45	17	22	80	110	16	22	60	90	350	500	26	31	28	3
Ulysses loam, 1 to 3 percent slopes	3.0	4.5	45	65	30	40	15	20	70	100	15	20	55	80	280	450	24	29	25	3
Ulysses loam, 3 to 6 percent slopes	2.0	4.0	40	55	25	35	13	18	60	90	12	18	50	70	200	400	21	25	22	2
Valentine and Dwyer fine sands, hilly	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Valentine and Dwyer fine sands, rolling	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Vetal fine sandy loam, 0 to 4 percent slopes	2.5	4.5	45	65	30	40	16	20	60	100	15	21	50	75	300	500	18	23	20	2

[1] Air-dry herbage consists of seeds, leaves, and stems.

etation differ, may be advisable. This helps to control overgrazing of the better sites, such as Sands, and undergrazing of the poorer sites, such as Gravelly. Fences are also needed to exclude animals from a pasture in a deferred grazing program.

Some range plants make their best growth in spring and fall, and others grow better in summer. Loamy and Clayey range sites produce cool-season grasses; Sands and Choppy Sands produce predominantly warm-season grasses.

Range condition also affects the proper season of use. Range sites in excellent condition are best utilized during periods of rapid plant growth because only maintenance of the present condition is required. However, range sites in fair condition improve only if grazing is deferred until the decreaser plants have matured.

Among the important practices that improve rangeland are range seeding, seeding tame grasses, development of livestock watering places, brush control, and deferred grazing.

Range seeding.—Rangeland that has been depleted by overgrazing and land in poor condition that has been allowed to revert to volunteer vegetation should be seeded with desirable grasses. If the area is to be used as native range, native grasses should be seeded. Such grasses as green needlegrass, western wheatgrass, and prairie sandreed occur naturally when the range is in good condition. These grasses are well suited to the climate, and seed is readily available. Green needlegrass and western wheatgrass are suitable for Loamy Overflow, Sandy, Loamy, and Clayey range sites. Prairie sandreed is suitable for Sands, Choppy Sands, and Sandy range sites.

Seeding tame grasses.—If tame grass pastures or haylands are needed, introduced species can be seeded. These include crested wheatgrass, intermediate wheatgrass, and Russian wildrye. These species need reestablishment periodically, and they require management different from native species. They should be fenced separately. Introduced grasses should be limited to the Loamy Overflow, Sandy Lowland, Loamy Lowland, Sandy, Loamy, Clayey, and Limy Upland range sites. These sites can be safely cultivated from time to time. Intermediate wheatgrass and Russian wildrye are well suited to Loamy Overflow range site. Crested wheatgrass is suited to the Sandy, Loamy, and Clayey range sites.

Development of livestock watering places.—The type of stock water development needed depends on the soil, the terrain, and the supply of ground water. Springs are important sources. Generally, one watering place is needed for each 40 to 60 animals, and these should be approximately 1 mile apart. Locating wells where they can water more than one pasture is advantageous. Stock water ponds and pits are suited to Clayey and Saline Upland range sites, and to some Loamy range sites. Wells with windmills are suited to all sites except the steeper parts of Shallow Sandy range sites. Storage tanks should be large enough to store a 7- to 10-day supply of water.

Brush control.—Only small acreages of brush occur in the Survey Area, but sand sagebrush, silver sagebrush, and yucca have invaded overgrazed areas of Sands range site. Brush control is economical if brush makes up 15 to 20 percent or more of the vegetation. Grazing should be deferred until the seed has matured for a period of 1 to 2 years after brush-control treatment.

Deferred grazing.—Deferred grazing and proper utilization of range are the most effective and least expensive methods of range improvement. The practice works best on range that is in fair to good condition. Once a range has deteriorated to poor condition, such practices as range seeding, pitting, and contour furrowing must be used in addition to deferred grazing. During April, May, and June, grazing animals should be excluded from range sites that produce cool-season grasses. They should be excluded during June, July, and August from range sites that produce warm-season grasses.

Range sites and condition classes

Range sites are distinctive kinds of rangeland. Each site has its own special combination of soils and climatic conditions that enables it to produce a distinctive kind and amount of native vegetation. Each site needs a different type of management to improve or maintain the desirable vegetation.

A successful range improvement program requires knowledge of the capabilities of the soils and of management techniques. Each range site has a distinctive potential vegetation. The potential vegetation refers to that combination of native plants that grow on a site under the best management conditions. The composition of the potential vegetation depends on a combination of environmental factors. The potential vegetation reproduces itself so long as environmental conditions remain the same.

The plants on any given range site are grouped, according to their response to grazing, as decreasers, increasers, and invaders. Decreasers are plants in the potential vegetation that tend to die out if heavily grazed. Increasers are plants in the potential vegetation that become more abundant as the decreasers decline, and then start to die out if heavy grazing continues. Invader plants are not part of the potential vegetation, but they generally take over under heavy grazing.

As the vegetation of a range site changes from predominantly decreaser to increaser and invader plants, the productivity and general health of the range decline. To indicate the degree to which a range has deteriorated from its potential, four classes of range condition are recognized.

A range site is in excellent condition if 76 to 100 percent of the present vegetation is of the same kind as the potential vegetation for the site. Decreaser plants dominate, and forage production is near the maximum for the site.

A range site is in good condition if 51 to 75 percent of the present vegetation is of the same composition as the potential vegetation. A few of the decreaser plants have been grazed out and have been replaced by increaser plants, but the general productivity is still good.

A range site is in fair condition if 26 to 50 percent of the present vegetation is of the same composition as the potential vegetation. With increaser plants dominant and weedy plants invading, production of palatable forage is unsatisfactory.

A range site is in poor condition if less than 25 percent of the present vegetation is of the same composition as the potential vegetation. Invader plants are abundant, and very few increaser and decreaser plants remain. Production is very limited.

Descriptions of range sites

The soils of Goshen County that produce similar kinds and amounts of vegetation have been grouped together into 13 range sites. The range sites are listed in their order of natural productivity.

The description of each range site includes estimates of annual herbage yields to be expected when the range site is in excellent condition. These yields represent the total air-dry weight of herbage and are made up of seeds, leaves, and stems. The forage provides grazing for cattle, sheep, antelope, and deer. Estimated yields for both dry and moist years are given.

In this Survey Area the Rock outcrop part of Rock outcrop-Tassel complex and of Rock land is not assigned to any range site, nor are the following land types: Alkali and saline land, Badlands, Dune land, Gullied land, Marsh and Wet land, and Mixed alluvial land. To find the range site for any given soil, refer to the "Guide to Mapping Units."

LOAMY LOWLAND RANGE SITE

This range site consists of deep and moderately deep, well-drained soils on flood plains of the North Platte River, the Laramie River, and Horse Creek. They have a deep, nonsaline and nonalkaline water table within the rooting depth of woody plants but not within reach of herbaceous plants.

Decreaser plants make up about 50 to 60 percent of the potential vegetation. These are switchgrass, western wheatgrass, and needle-and-thread. Increaser plants are blue grama, forbs, and cottonwood. Invader plants are curlycup gumweed and annuals.

When this site is in excellent condition, it produces about 1,700 pounds of air-dry herbage per acre in dry years and about 3,000 pounds per acre in moist years. The annual production of forage suitable for cattle is about 1,400 pounds per acre in dry years and about 2,400 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 1,500 pounds per acre in dry years and about 2,700 pounds per acre in moist years.

SANDY LOWLAND RANGE SITE

This range site consists of deep, well drained to excessively drained soils. The soils are fine sandy loams and loamy fine sands on flood plains of perennial streams. They have a deep, nonsaline and nonalkaline water table within the rooting depth of woody plants but not within that of herbaceous plants.

Decreaser plants make up about 50 to 60 percent of the potential vegetation. These are mainly prairie sandreed, Indian ricegrass, sand bluestem, and needle-and-thread. Increaser plants are western wheatgrass, blue grama, threadleaf sedge, sagewort, and cottonwood. Invader plants are curlycup gumweed and annuals.

When this site is in excellent condition, it produces about 1,600 pounds of air-dry herbage per acre in dry years and about 3,000 pounds per acre in moist years. The annual production of forage suitable for cattle is about 1,300 pounds per acre in dry years and about 2,400 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 1,400 pounds per acre in dry years and about 2,700 pounds per acre in moist years.

LOAMY OVERFLOW RANGE SITE

This range site consists of deep, well-drained soils, mainly in upland swales and shallow drainageways throughout the Survey Area. It receives runoff from adjacent slopes, and consequently, more than the normal amount of moisture.

Decreaser plants make up about 50 to 60 percent of the potential vegetation. These are big bluestem, little bluestem, green needlegrass, slender wheatgrass, and switchgrass. Increaser plants are western wheatgrass, needle-and-thread, blue grama, and buffalograss. Invader plants are thistle, curlycup gumweed, and annuals.

When this site is in excellent condition, it produces about 1,200 pounds of air-dry herbage per acre in dry years and about 2,500 pounds per acre in moist years. The annual production of forage suitable for cattle is about 1,000 pounds per acre in dry years and about 2,000 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 1,100 pounds per acre in dry years and about 2,200 pounds per acre in moist years.

SANDS RANGE SITE

This range site consists of deep, excessively drained soils on uplands in the northern and eastern parts of the Survey Area. The soils are gently sloping to moderately steep.

Decreaser plants make up about 60 to 70 percent of the potential vegetation. These are mainly prairie sandreed, which makes up 50 percent or more of the vegetation, and sand bluestem and Indian ricegrass. Increaser plants are needle-and-thread, sand dropseed, sand sagebrush, blue grama, forbs, and yucca. Sand sagebrush increases rapidly if the site is overgrazed. Invader plants are woolly plantain, cheatgrass, and annuals. This site is highly susceptible to wind erosion, and a good vegetative cover should be maintained at all times.

When this site is in excellent condition, it produces about 900 pounds of air-dry herbage per acre in dry years and about 1,800 pounds per acre in moist years. The annual production of forage suitable for cattle is about 700 pounds per acre in dry years and about 1,400 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 800 pounds per acre in dry years and about 1,600 pounds per acre in moist years.

CHOPPY SANDS RANGE SITE

This range site consists of deep, loose, excessively drained soils. The areas are in the northeastern part of the Survey Area and are characterized by stabilized dunes and blowouts. The slopes are irregular and steep.

Decreaser plants make up about 60 to 90 percent of the potential vegetation. The main decreaser plants are prairie sandreed, sand bluestem, and Indian ricegrass. Increaser plants are sagebrush, needle-and-thread, and sand dropseed. The principal invader plants are annual eriogonum, cheatgrass, and annuals. This site is easily eroded by wind, and a good vegetative cover should be maintained at all times.

When this site is in excellent condition, it produces about 700 pounds of air-dry herbage per acre in dry years and about 1,800 pounds per acre in moist years. The annual production of forage suitable for cattle is about 600 pounds per acre in dry years and about 1,400 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 600 pounds per acre in dry years and about 1,600 pounds per acre in moist years.

SANDY RANGE SITE

This range site consists of deep, well-drained and excessively drained soils that occur on uplands and alluvial fans. These soils are nearly level to moderately steep fine sandy loams and loamy fine sands.

Decreaser plants make up about 50 to 60 percent of the potential vegetation. These are needle-and-thread, Indian ricegrass, sand bluestem, and prairie sandreed. Increaser plants are blue grama, threadleaf sedge, western wheatgrass, sagewort, Sandberg bluegrass, and sand dropseed. Invader plants are cheatgrass, cactus, broom snakeweed, curlycup gumweed, and thistle. This site deteriorates quickly if it is overgrazed, and blue grama thickens.

When this site is in excellent condition, it produces about 600 pounds of air-dry herbage per acre in dry years and about 1,800 pounds per acre in moist years. The annual production of forage suitable for cattle is about 500 pounds per acre in dry years and about 1,400 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 500 pounds per acre in dry years and about 1,600 pounds per acre in moist years.

LOAMY RANGE SITE

This range site consists of deep and moderately deep, well-drained soils on uplands and alluvial fans throughout most of the Survey Area. These soils consist of nearly level to moderately steep, very fine sandy loams, loams, and silt loams. Included in this range site are fine sandy loams that have a subsoil of loam or clay loam.

Decreaser plants make up 50 to 60 percent of the potential vegetation. These are western wheatgrass, green needlegrass, and needle-and-thread. Increaser plants are blue grama, threadleaf sedge, buffalograss, Sandberg bluegrass, sagewort, and forbs. Broom snakeweed, cheatgrass, six-weeks fescue, cactus, and annuals invade sites in poor condition. If this site is overgrazed, the decreaser plants die out and blue grama thickens to dense stands.

When this site is in excellent condition, it produces about 600 pounds of air-dry herbage per acre in dry years and about 1,800 pounds per acre in moist years. The annual production of forage suitable for cattle is about 500 pounds per acre in dry years and about 1,400 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 500 pounds per acre in dry years and about 1,600 pounds per acre in moist years.

CLAYEY RANGE SITE

This range site consists of deep, well-drained, nearly level to sloping soils on fans and valley side slopes in the central part of the Survey Area. The texture is clay loam and clay.

Decreaser plants make up 60 to 70 percent of the potential vegetation. These are western wheatgrass, green needlegrass, Indian ricegrass, and winterfat. Increaser plants are blue grama, buffalograss, threadleaf sedge, and sagewort. Invader plants are broom snakeweed, western ragweed, and annuals.

When this site is in excellent condition, it produces about 500 pounds of air-dry herbage per acre in dry years and about 1,700 pounds per acre in moist years. The annual production of forage suitable for cattle is about 400 pounds per acre in dry years and about 1,400 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 400 pounds per acre in dry years and about 1,500 pound per acre in moist years.

LIMY UPLAND RANGE SITE

This range site consists of deep, well-drained soils on uplands in the southern and western parts of the Survey Area. Soils of this range site are light-colored, calcareous loams. They are nearly level to moderately steep.

Decreaser plants make up 50 to 60 percent of the potential vegetation. These are western wheatgrass, green needlegrass, and needle-and-thread. Threadleaf sedge increases rapidly to almost solid stands if the site is overgrazed. Other increaser plants are blue grama and red three-awn. Invader plants are annuals and western ragweed.

When this site is in excellent condition, it produces about 600 pounds of air-dry herbage per acre in dry years and about 1,300 pounds per acre in moist years. The annual production of forage suitable for cattle is about 500 pounds per acre in dry years and about 1,000 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 500 pounds per acre in dry years and about 1,200 pounds per acre in moist years.

SHALLOW SANDY RANGE SITE

This range site consists of well-drained soils on uplands in the southern and western parts of the Survey Area. Soils of this range site have a fine sandy loam texture and are underlain by soft sandstone. They are gently sloping to steep.

Decreaser plants make up 60 to 70 percent of the potential vegetation. These are little bluestem, side-oats grama, bluebunch wheatgrass, needle-and-thread, plains muhly, prairie junegrass, Indian ricegrass, and mountain-mahogany. Increaser plants are threadleaf sedge, blue grama, red three-awn, sand dropseed, sagewort, skunkbush, and perennial eriogonum. Other increaser plants are Rocky Mountain juniper and ponderosa pine. Invader plants are broom snakeweed, cactus, and annuals.

When this site is in excellent condition, it produces about 600 pounds of air-dry herbage per acre in dry years and about 1,300 pounds per acre in moist years. The annual production of forage suitable for cattle is about 400 pounds per acre in dry years and about 700 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 500 pounds per acre in dry years and about 1,000 pounds per acre in moist years.

SHALLOW LOAMY RANGE SITE

This range site consists of well-drained soils on uplands in the central and southeastern parts of the Survey Area. Soils of this range site are underlain by soft siltstone and interbedded sandstone and shale. They are nearly level to moderately steep.

Decreaser plants make up about 50 to 60 percent of the potential vegetation. These are little bluestem, side-oats grama, bluebunch wheatgrass, western wheatgrass, and needle-and-thread. Increaser plants are blue grama, threadleaf sedge, red three-awn, and sagewort. Invader plants are broom snakeweed and annuals.

When this site is in excellent condition, it produces about 500 pounds of air-dry herbage per acre in dry years and about 1,200 pounds per acre in moist years. The annual production of forage suitable for cattle is about 300 pounds per acre in dry years and about 700 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 400 pounds per acre in dry years and about 1,000 pounds per acre in moist years.

SALINE UPLAND RANGE SITE

This range site consists of shallow, well-drained soils on uplands in the central part of the Survey Area. These soils are nearly level to moderately steep. They have clay texture and are strongly alkaline.

Decreaser plants make up 60 to 70 percent of the potential vegetation. These are western wheatgrass, needle-and-thread, and Gardner saltbush. Increaser plants are blue grama, buffalograss, and greasewood. Russian-thistle and annuals invade if the site is overgrazed.

When this site is in excellent condition, it produces about 500 pounds of air-dry herbage per acre in dry years and about 1,000 pounds per acre in moist years. The annual production of forage suitable for cattle is about 400 pounds per acre in dry years and about 800 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 400 pounds per acre in dry years and about 900 pounds per acre in moist years.

GRAVELLY RANGE SITE

This range site consists of well-drained to excessively drained soils on terrace rims in the northern and southern parts of the Survey Area. These soils are gravelly sands. They are gently sloping to steep.

Decreaser plants make up 70 to 80 percent of the potential vegetation. These are side-oats grama, little bluestem, Indian ricegrass, prairie sandreed, beardless and bluebunch wheatgrass, needle-and-thread, and prairie-clover. Blue grama, threadleaf sedge, and red three-awn increase rapidly if the site is overgrazed. Other increaser plants are sand dropseed, sagewort, Sandberg bluegrass, and forbs. Invader plants are cheatgrass, broom snakeweed, cactus, and annuals.

When this site is in excellent condition, it produces about 300 pounds of air-dry herbage per acre in dry years and about 900 pounds per acre in moist years. The annual production of forage suitable for cattle is about 200 pounds per acre in dry years and about 700 pounds per acre in moist years. The annual production of forage suitable for sheep, antelope, and deer is about 200 pounds per acre in dry years and about 800 pounds per acre in moist years.

Management of the Soils for Windbreaks [5]

Most of the southern part of Goshen County is treeless. Trees occur naturally only on the flood plains along the North Platte River and certain tributaries and on rough, rocky escarpments.

Cottonwoods and willows grow on the Bankard, Glenberg, Haverson, and McCook soils and on Mixed alluvial land. These trees have no commercial value for wood crops other than fuelwood. They are used mainly for streambank protection, for protection of livestock during blizzards, and for wildlife cover.

Stunted ponderosa pine and Rocky Mountain juniper grow on the rocky escarpments and toe slopes mapped as Rock land and Rock outcrop-Tassel complex. They have no commercial value. Fence posts can be cut from juniper stands if the trees are large enough. Also in this area are skunkbush, sumac, mountain-mahogany, currant, and other shrubs.

Farmers and ranchers have planted many trees in the Survey Area. Most of the plantings are windbreaks, which are needed as protection for farmsteads, feedlots, and cultivated fields (fig. 12). Windbreaks provide protection against the cold northerly or westerly wind in winter, trap blowing snow, control snowdrift, reduce wind erosion, provide food and shelter for wildlife, provide shade in summer, and add esthetic appeal to the landscape.

A windbreak provides protection for a distance of about 20 times the height of the trees. Low-growing shrubs should be planted in the rows on the windward side, medium or tall shrubs in the next rows, and tall trees in the center or in the leeward rows. For maximum protection in winter, each windbreak should have two or more rows of evergreens, for example, Rocky Mountain juniper or ponderosa pine. If the moisture supply is adequate, as in irrigated areas, Colorado blue

[5] By W. S. SWENSON, woodland conservationist, Soil Conservation Service.

Figure 12.—**A good farmstead windbreak on Manter and Anselmo fine sandy loams, 0 to 3 percent slopes. This soil is in the Sandy windbreak site.**

spruce can be used advantageously. Evergreens live longer and provide more protection than broadleaf trees, but they are harder to establish and they grow more slowly.

Tree planting

Preparation for planting trees varies among the soils in the Survey Area. For example, Keith and Mitchell soils, which are in the Silty to Clayey windbreak site, should be summer fallowed for a year before planting. Anselmo and Manter soils, which are sandy and are readily blown if left uncovered, require only a narrow strip of fallow for each tree row. Natural cover or planted cover between the tree rows protects the seedlings from strong wind.

Some soils that receive extra water from runoff or from a water table can be used for water-tolerant species of trees and shrubs. Droughty soils can be used for certain species. Other soils cannot be used for trees because of texture, alkalinity, salinity, slope, or wetness.

Maintaining plantings

After a planting has been established, maintaining the planting in a healthy condition is most important. Protect it from fire. Build fences to keep out livestock. Use commercial repellants to protect seedlings from deer, antelope, rabbits, and rodents. Replace trees and shrubs that die during the first few years so that the windbreak develops uniformly. Prune only the dead limbs and unsightly growth. Spray to protect the trees from insects and disease wherever needed.

Windbreak sites

The soils of the Survey Area have been grouped in five windbreak sites. Each site supports similar kinds of trees, needs similar management, and produces about the same growth of trees and shrubs. Not included in the groupings are Alkali and saline land, Badlands, Dune land, Gullied land, and Mixed alluvial land. To find the site for any given soil, refer to the "Guide to Mapping Units."

SILTY TO CLAYEY WINDBREAK SITE

This site consists of deep and moderately deep, well-drained loams, silt loams, and clay loams.

Caragana, lilac, plum, and sumac are suitable shrubs for this site. Austrian pine, eastern redcedar, ponderosa pine, and Rocky Mountain juniper are suitable conifers. Russian-olive is a suitable short broadleaf tree, and green ash, hackberry, and Siberian elm are suitable medium and tall broadleaf trees.

Summer fallow a nonirrigated site for 1 year before planting. Build diversion ditches to collect water and carry it onto the site. Use snow fences to drift snow onto the plantings. If the surface layer is dry at planting time, water the seedlings after planting. Practice clean cultivation between tree rows for as long as possible.

If the site is to be irrigated, prepare the irrigation system before planting. Prepare a clean seedbed, and irrigate as needed. Practice clean cultivation only until trees are about 3 years old.

SANDY WINDBREAK SITE

This site consists of deep and moderately deep, well-drained very fine sandy loams, fine sandy loams, and sandy loams, and the loamy fine sands that are suitable for dryfarmed crops.

Caragana, chokecherry, lilac, sand cherry, and sumac are suitable shrubs for this site. Austrian pine, eastern redcedar, ponderosa pine, and Rocky Mountain juniper are suitable conifers. Russian-olive is a suitable short broadleaf tree, and green ash, hackberry, and Siberian elm are suitable medium and tall broadleaf trees.

On nonirrigated sites, summer fallow only the strips for tree rows. Maintain natural ground cover, or plant cover crops between the tree rows to prevent the soil from drifting and blasting trees. Plant on the contour if the slope is in a favorable direction and is more than 3 percent. Use snow fences to drift snow onto the plantings.

If the site is to be irrigated, prepare the irrigation system before planting. Irrigate more frequently on this site than on the Silty to Clayey site, but in smaller amounts.

VERY SANDY WINDBREAK SITE

This site consists of deep, excessively drained sands, including the loamy fine sands that are generally not suitable for dryfarmed crops.

Sumac is a suitable shrub for this site. Austrian pine, ponderosa pine, and Rocky Mountain juniper are suitable conifers. None of the short, medium, or tall broadleaf trees is suitable for planting.

This site is seldom irrigated. Prepare narrow strips for each tree row. Maintain natural cover or plant cover between the tree rows. Plant only drought-tolerant trees and shrubs. Plant on the contour if possible. Cultivate to control weeds and conserve moisture. Use snow fences to drift snow onto tree plantings and to protect seedlings. Place wood shingles around evergreens for the first 2 or 3 years.

MODERATELY WET WINDBREAK SITE

Marsh and Wet land, 0 to 5 percent slopes, is the only mapping unit in this site. This land is somewhat poorly drained because of floods or a high water table.

Caragana, chokecherry, honeysuckle, lilac, plum, cherry, and sumac are suitable shrubs for this site. Austrian pine, blue spruce, eastern redcedar, ponderosa pine, and Rocky Mountain juniper are suitable conifers. Russian-olive is a suitable short broadleaf tree, and cottonwood, golden willow, green ash, hackberry, Siberian elm, and white willow are suitable medium and tall broadleaf trees.

Prepare a clean seedbed; remove the sod by plowing, disking, and harrowing. If water is near the surface, plant willow, cottonwood, or other water-tolerant trees. Practice clean cultivation until the trees are taller than the weeds.

UNSUITABLE WINDBREAK SITE

In this site are shallow soils, saline and alkali soils, loose sands on choppy slopes, and very poorly drained soils, all of which are very poor sites for trees. Most plantings on these soils are unsuccessful.

Management of the Soils for Wildlife [6]

The kinds and numbers of wildlife in an area are determined by the kind and amount of vegetation and the land use, both of which are influenced by the fertility of the soils, by irrigation, and by topography and the kind of farming. In rough areas that are generally grazed, for example, the amount of vegetation left in fall is most important in determining wildlife population.

Table 3 shows the potential of the soils, by soil association, as habitat for specified kinds of wildlife. The potential is based on the characteristics of the major soils in the association. Dashes in a column indicate the habitat element is not required for a given species. The location of the eight soil associations in the Survey Area is shown on the general soil map at the back of this survey.

The capacity of a soil to hold water is an important factor in determining wildlife species. It is also important in planning water developments for fish, waterfowl, and furbearers. Marshes, springs, and other natural water areas should be protected and maintained or improved as aquatic and marsh habitat. Topography, too, determines where marshes and fishponds can be developed. Deep canyons with steep sides are needed for fishponds, and shallow basins with gradual sloping sides for waterfowl developments.

The vegetation in the Survey Area provides habitat for a variety of wildlife species. Important game species include pheasant, waterfowl, sharp-tailed grouse, deer, antelope, and cottontail rabbits. There are a few fox squirrels. Beaver are to be found along the North Platte River and smaller creeks, and raccoon frequent all water areas. Red fox, weasel, and skunks are found throughout the Area. Rivers, creeks, and large lakes, as well as irrigation reservoirs, are stocked with fish, including trout, and there are a few stocked ponds. Songbirds are abundant. They are especially attracted to areas that provide woody cover.

The largest population of pheasants is to be found in irrigated areas and along wooded draws. Protection of vegetation in unused areas, in coulees, on ditchbanks, and along fence rows provides winter cover and nesting sites.

Waterfowl migrate through the Area, and many remain to nest. Springer and Hawk Springs Reservoirs provide water. The Springer and Table Mountain waterfowl developments of the Wyoming Game and Fish Commission provide ideal nesting and feeding places for Canadian geese, mallards, teal, shovellers, and a variety of shore birds. At Springer Lake there is a rookery for great blue heron.

The large part of the Area in range is potential habitat for sharp-tailed grouse. It can be improved by proper range use.

The inadequate water supply in much of the Area limits the wildlife population. Water developments benefit many species. The clay soils of the Kim, Heldt, and Orella series provide a possibility for impounding

[6] By L. M. Moos, biologist, Soil Conservation Service.

TABLE 3.—*Potential of soils, by soil association, for wildlife habitat*

Soil association	Wildlife species	Potential for—			
		Woody cover	Herbaceous cover	Aquatic environment	Food
1. Satanta-Mitchell association.	Pheasant	Very good	Very good		Very good.
	Sharp-tailed grouse		Good		Good.
	Deer	Good	Good		Good.
	Antelope		Good		Good.
	Rabbit	Good	Good		Good.
2. Rosebud-Norka-Creighton association.	Pheasant	Good	Good		Good.
	Sharp-tailed grouse		Very good		Very good.
	Deer	Good	Good		Good.
	Antelope		Good		Very good.
	Rabbit	Good	Good		Good.
3. Anselmo-Manter-Dwyer association.	Pheasant	Good	Good		Good.
	Sharp-tailed grouse		Good		Good.
	Deer	Good	Good		Good.
	Antelope		Good		Good.
	Rabbit	Good	Good		Good.
4. Dunday-Trelona-Dwyer association.	Pheasant	Fair	Fair		Fair.
	Sharp-tailed grouse		Fair		Fair.
	Deer	Very good	Very good		Very good.
	Antelope		Fair		Fair.
	Rabbit	Good	Good		Good.
5. Valentine-Dwyer association.	Pheasant	Fair	Good		Good.
	Sharp-tailed grouse		Very good		Very good.
	Deer	Fair	Fair		Fair.
	Antelope		Good		Good.
	Rabbit	Fair	Good		Good.
6. Mitchell-Bordeaux-Epping association.	Pheasant	Fair	Fair		Fair.
	Sharp-tailed grouse		Good		Good.
	Deer	Good	Good		Good.
	Antelope		Good		Good.
	Rabbit	Good	Good		Good.
7. Kim-Orella-Heldt association.	Pheasant	Good	Good		Good.
	Sharp-tailed grouse		Fair		Fair.
	Deer	Fair	Fair		Fair.
	Antelope		Fair		Fair.
	Rabbit	Good	Good		Good.
	Waterfowl			Very good	Very good.
	Furbearers		Very good	Very good	Very good.
	Fish			Very good	
8. Haverson-Bankard association.	Pheasant	Very good	Very good		Very good.
	Sharp-tailed grouse		Good		Very good.
	Deer	Very good	Very good		Very good.
	Antelope		Fair		Fair.
	Rabbit	Very good	Very good		Very good.
	Waterfowl			Very good	Very good.
	Furbearers	Very good	Very good	Very good	Very good.
	Fish			Very good	

water for fish and establishing marsh habitat for waterfowl. Irrigation water can be used to insure permanent water levels. A depth of at least 10 feet is needed in winter for the production of trout and warmwater species. Developments for waterfowl should be shallow to insure good growth of aquatic and marsh plants. They should be fenced in and protected from grazing animals to provide nesting sites. Planting woody species in the protected area attracts additional wildlife. Developing wildlife habitat, especially waterfowl habitat, for lease to hunters is a possible source of income. Some soils are best suited to this use.

Farmstead or field windbreaks, hedgerows, and other woody plantings benefit most kinds of wildlife, including insect-eating songbirds. Planting and protecting vegetation for wildlife food and cover contribute significantly to the wildlife in the Area.

Engineering Uses of the Soils [7]

In engineering, soil is used as structural material or as foundation material upon which structures rest. Some soil properties are of special interest to engineers, contractors, and others involved in the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the soil properties most important in engineering and construction are permeability, shear strength, compaction characteristics, grain size, plasticity, and reaction. The depth to the water table, depth to bedrock, and topography are also important in planning engineering works.

Tables 4, 5, and 6 give information concerning these and related soil properties. The estimates and interpretations of soil properties in these tables can be used in:

1. Planning agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.
2. Selecting potential highway, airport, pipeline, and cable locations.
3. Locating probable sources of sand, gravel, or rock for use in contruction.
4. Selecting potential industrial, business, residential, and recreational sites.
5. Supplementing the information obtained from other published maps, reports, or aerial photographs to prepare maps and reports that can be used readily by engineers.
6. Developing other preliminary estimates for construction purposes pertinent to the particular area.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some terms used by soil scientists have a different meaning in soil science than they have in engineering. The Glossary defines many such terms as they are used in soil science.

Engineering classification systems

The two systems most commonly used in classifying soils for engineering use are the Unified system developed by the Corps of Engineers (*12*) and the one developed by the American Association of State Highway Officials (AASHO) (*1*). Classification of the soils of this Survey Area according to both of these systems is given in this survey.

In the Unified system, soil materials are grouped into 15 classes: eight classes are for coarse-grained material, six for fine-grained material, and one for highly organic material. Each group is identified by a letter symbol. For example, the symbols SW and SP identify clean sands; SM and SC identify sands with nonplastic or plastic fines; GW and GP identify clean gravel; GM and GC identify gravelly soils with nonplastic or plastic fines; ML and CL identify fine-grained material, either plastic or nonplastic, if the liquid limit is low; and MH and CH identify such material if the liquid limit is high.

Under the AASHO system soil materials are classified according to properties that affect their use in highway construction. Soils are classified into seven principal groups, designated A–1 through A–7, according to load-carrying capacity and service. The best soils for subgrade are classified as A–1, the next best as A–2, and so on to class A–7, the poorest soils for subgrade.

The estimated range in percentage passing sieves Nos. 4, 10, and 200 reflects the normal range for a soil series. The grain size of any soil varies considerably, however, and it should not be assumed that all samples of a specific soil will fall within the range shown, nor that the engineering classification given will invariably be as shown.

The U.S. Department of Agriculture system of classifying soils according to texture is primarily for agricultural use, but the textural classification is useful in engineering also. In this system, soils are classified according to the proportional amounts of different sizes of mineral particles. A soil that is 40 percent clay particles, for example, is called clay.

The Unified and AASHO classifications of tested soils are shown in table 6. The estimated classifications of all the soils of the Survey Area according to these systems are shown in table 4.

Estimated engineering properties

Estimates of soil properties significant in engineering are given in table 4. These estimates are based on the test data in table 6, on comparison of other soils with those tested, and on experience in the field.

The depth to bedrock is not shown in this table, because it is more than 60 inches in all soils except those of eight series. For those series the depth to bedrock is as follows:

[7] By D. J. TOKACH, assistant State conservation engineer, Soil Conservation Service.

TABLE 4.—*Estimated engineering*

[Estimated properties are not given for miscellaneous land types,

Soil series and map symbols	Depth from surface	Classification		
		Dominant USDA texture	Unified	AASHO
	In.			
Alkali and saline land: **AK.** Properties variable.				
Anselmo:				
Fine sandy loam: **AlB, AmA, AmB, AmC, AmD, AsA, AsC, AsD.**	0–60	Fine sandy loam	SM or SC	A–4
Loamy fine sand: **AtA.** For Dwyer part of **AmA, AmB, AmC,** and **AmD,** see Dwyer loamy fine sand. For Shingle part of **AsA, AsC,** and **AsD,** see Shingle series. For Trelona part **AtA,** see Trelona loamy fine sand.	0–12 12–60	Loamy fine sand Fine sandy loam	SM SM or SC	A–2 A–4
Ascalon: **AuB, AuC.**	0–15 15–27 27–40 40–60	Fine sandy loam Sandy clay loam Very fine sandy loam Gravelly fine sandy loam	SM SM or SC ML or CL SM	A–4 A–4 A–4 A–4
Badlands: **Bd.** Properties variable.				
Bankard: **BfA, BfB.**	0–9 9–48 48–60	Loamy fine sand Fine sand Sand and gravel	SM SM SP or SM	A–2 A–1 A–1
Bayard: **BgB, BoA, BoB.** For Otero part of **BoA** and **BoB,** see Otero series.	0–60	Fine sandy loam	SM	A–4
Bordeaux: **BrA, BrB, BrC.**	0–18 18–60	Fine sandy loam Loam	SM ML	A–4 A–4
Chappell: **ChB, ChC, ClD.** For Hawksprings parts of **ChB** and **ChC,** see Hawksprings series. For Dix part of **ClD,** see Dix series.	0–32 32–48	Fine sandy loam Sand and gravel	SM SP or SM	A–4 A–1
Colby: **CoC, CoD, CtC.** For Tassel part of **CtC,** see Tassel series.	0–60	Loam	ML or CL	A–4
Creighton: **CvB, CvC, CvD.**	0–60	Very fine sandy loam	ML or CL	A–4
Dix: **DcD, DcE.**	0–7 7–13 13–48	Gravelly fine sandy loam Gravelly sand Very gravelly sand	SM SP SP	A–4 A–1 A–1
Dunday: **DdA, DdC, DeE, DfA, DfC.** For Dwyer part of **DdA** and **DdC,** see Dwyer loamy fine sand. For Trelona part of **DeE,** see Trelona fine sandy loam. For Vetal part of **DfA** and **DfC,** see Vetal loamy fine sand.	0–60	Loamy fine sand	SM	A–2
Dune land: **Dn.** Properties variable.				
Duroc: **DuA, DuB.**	0–60	Loam	ML	A–4
Dwyer:				
Loamy fine sand: **DwA, DwC, DyD.** For Mitchell part of **DyD,** see Mitchell series.	0–60	Loamy fine sand	SM	A–2
Fine sand.	0–60	Fine sand	SP	A–3
Epping: **EpB, EpC, EpD.**	0–9 9	Silt loam Siltstone.	ML	A–4
Glenberg: **GbA.**	0–60	Fine sandy loam	SM	A–4
Goshen: **GkA.** For Kuma part of **GkA,** see Kuma series.	0–20 20–29 29–60	Loam Clay loam Loam	ML or CL CL ML or CL	A–4 A–6 A–4

properties of the soils

because the soil material is too variable for reliable evaluation]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	*In./hr.*	*In./in. of soil*	*pH*		
100	100	35–50	2.0–6.3	0.13	7.4–8.4	Low	Low.
100	100	20–35	>6.3	.08	7.4–7.8	Low	Low.
100	100	35–50	2.0–6.3	.13	7.4–8.4	Low	Low.
95–100	90–100	35–50	2.0–6.3	.13	6.6–7.3	Low	Low.
95–100	90–100	35–50	0.63–2.0	.15	6.6–7.3	Low	Low.
95–100	90–100	50–65	0.63–2.0	.17	6.6–8.4	Low	Low.
90–100	80–100	35–50	2.0–6.3	.13	7.9–8.4	Low	Low.
100	100	25–35	>6.3	.08	7.9–8.4	Low	Low.
90–100	85–100	10–20	>6.3	.05	7.9–8.4	Low	Low.
60–70	40–50	0–10	>6.3	.03	7.9–8.4	Low	Low.
100	100	35–50	2.0–6.3	.13	7.9–8.4	Low	Low.
100	100	35–50	2.0–6.3	.13	7.4–8.4	Low	Low.
100	100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Low.
90–100	80–100	35–50	2.0–6.3	.13	7.4–8.4	Low	Low.
60–70	40–50	0–10	> 6.3	.03	7.9–8.4	Low	Low.
100	100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Low.
100	95–100	50–65	0.63–2.0	.17	7.4–8.4	Low	Low.
80–90	80–90	35–50	2.0–6.3	.12	7.4–7.8	Low	Low.
50–70	40–50	0–10	>6.3	.05	7.4–7.8	Low	Low.
50–70	40–50	0–10	>6.3	.03	7.4–7.8	Low	Low.
100	100	20–35	>6.3	.08	6.6–8.4	Low	Low.
100	100	65–80	0.63–2.0	.17	7.4–8.4	Low	Low.
100	100	20–35	>6.3	.08	7.9–8.4	Low	Low.
100	100	4–12	>6.3	.06	7.9–8.4	Low	Low.
100	90–100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Low.
95–100	90–100	35–50	2.0–6.3	.13	7.9–8.4	Low	Low.
100	100	65–80	0.63–2.0	.17	7.4–7.8	Low	Low.
100	100	75–90	0.63–2.0	.17	7.4–7.8	Low	Moderate.
100	100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Low.

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		Dominant USDA texture	Unified	AASHO
	In.			
Gullied land: Gu. Properties variable.				
Hargreave.	0–8	Very fine sandy loam	ML or CL	A–4
	8–12	Sandy clay loam	CL	A–6
	12–33	Very fine sandy loam	ML or CL	A–4
	33	Soft sandstone.		
Haverson:				
Fine sandy loam: HaA.	0–10	Fine sandy loam	SM	A–4
	10–60	Loam	ML	A–4
Loam, gravel substratum variant: HgA.	0–24	Loam	ML	A–4
	24–60	Sand and gravel	SP or SM	A–1
Loam: HnA. For McCook part of HnA, see McCook series.	0–60	Loam	ML	A–4
Hawksprings.	0–32	Sandy loam	SM	A–4
	32–60	Sand and gravel	SP or SM	A–1
Heldt: HtA.	0–60	Clay, silty clay	CH	A–7
Keith: KeA, KeB, KeC.	0–10	Loam	ML or CL	A–4
	10–22	Clay loam, loam	CL	A–6
	22–60	Loam	ML or CL	A–4
Keota: KoA, KoB, KpD. For Epping part of KpD, see Epping series.	0–32	Loam	ML	A–4
	32	Soft siltstone.		
Kim: KyA, KyB, KyC.	0–60	Clay loam	CL	A–7
Kuma.	0–14	Loam	ML or CL	A–4
	14–36	Clay loam	CL	A–6
	36–60	Loam, sandy clay loam	ML or CL	A–4
Manter: MeA, MeB, MeC. For Anselmo part of MeA, MeB, and MeC, see Anselmo fine sandy loam.	0–60	Fine sandy loam, very fine sandy loam.	SM or SC	A–4
Marsh and Wet land: MaB. Properties variable.				
McCook.	0–60	Loam	ML	A–4
Mitchell: MsA, MsC, MtA, MtB, MtC, MtD. For Shingle part of MsA and MsC, see Shingle series.	0–60	Loam	ML	A–4
Mixed alluvial land: Mu. Properties variable.				
Norka: NoA, NoB, NrB, NwB, NwC. For Colby part of NrB, see Colby series. For Weld part of NwB, and NwC, see Weld series.	0–3	Loam	ML	A–4
	3–12	Clay loam	CL	A–7
	12–60	Loam, very fine sandy loam.	ML	A–4
Orella: OcA, OeD. For Epping part of OeD, see Epping series.	0–12	Clay	CH	A–7
	12	Shale.		
Otero: OtA, OtB, OtC.	0–60	Fine sandy loam	SM	A–4
Rock land: Rc. Properties variable for Rock outcrop part. For Dunday, Dwyer, Tassel, and Trelona parts, see the appropriate series.				
Rock outcrop: Rd. Properties variable. For Tassel part, see Tassel series.				

properties of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	*In./hr.*	*In./in. of soil*	*pH*		
100	100	50–65	0.63–2.0	.17	6.6–7.3	Low	Low.
100	100	50–65	0.63–2.0	.17	6.6–7.3	Low	Moderate.
100	100	50–65	0.63–2.0	.17	6.6–7.3	Low	Low.
100	100	35–50	2.0–6.3	.13	7.9–8.4	Low	Low.
100	100	60–75	0.63–2.0	.17	7.9–8.4	Low	Low.
100	100	60–75	0.63–2.0	.17	7.9–8.4	Low	Low.
60–70	40–50	0–10	>6.3	.03	7.9–8.4	Low	Low.
100	100	60–75	0.63–2.0	.17	7.9–8.4	Low	Low.
90–100	80–100	35–50	2.0–6.3	.13	7.4–7.8	Low	Low.
60–70	40–50	0–10	>6.3	.03	7.4–8.4	Low	Low.
100	100	90–100	0.20–0.63	.17	7.9–9.0	Moderate	High.
100	100	65–80	0.63–2.0	.17	7.4–7.8	Low	Low.
100	100	75–90	0.63–2.0	.17	7.4–7.8	Low	Moderate.
100	100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Low.
100	100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Low.
100	100	75–90	0.20–0.63	.17	7.9–9.0	Moderate	Moderate to high.
100	100	65–80	0.63–2.0	.17	6.6–7.3	Low	Low.
100	100	75–90	0.63–2.0	.17	7.4–7.8	Low	Moderate.
100	100	65–80	0.63–2.0	.17	7.4–7.8	Low	Low.
100	100	35–50	2.0–6.3	.13	7.4–8.4	Low	Low.
100	100	60–75	0.63–2.0	.17	7.9–8.4	Moderate	Low
100	100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Low.
100	100	70–85	0.63–2.0	.17	7.4–7.8	Low	Low.
100	100	80–95	0.63–2.0	.17	7.4–7.8	Low	Moderate.
100	100	75–90	0.63–2.0	.17	7.9–9.0	Moderate	Low.
100	100	85–100	0.05–0.20	.15	>9.0	Moderate to high	High.
100	95–100	35–50	2.0–6.3	.13	7.9–8.4	Low	Low.

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		Dominant USDA texture	Unified	AASHO
	In.			
Rosebud:				
Loamy fine sand: ReA, ReC.	0–6	Loamy fine sand	SM	A–2
For Dunday part, see Dunday series. For Trelona part, see Trelona loamy fine sand.	6–11	Sandy clay loam	CL	A–6
	11–39	Very fine sandy loam	ML or CL	A–4
	39	Sandstone.		
Fine sandy loam: RhB, RhC, RuB, RuC, RuD.	0–3	Fine sandy loam	SM	A–4
For Hargreave part of RhB and RhC, see Hargreave series. For Trelona part of RuB, RuC, and RuD, see Trelona fine sandy loam.	3–11	Sandy clay loam	CL	A–6
	11–39	Very fine sandy loam	ML or CL	A–4
	39	Sandstone.		
Loam: RnA, RnB, RnC, RsA, RtB.	0–6	Loam	ML or CL	A–4
For Norka part of RnA, RnB, and RnC, see Norka series. For Satanta part of RsA, see Satanta loam. For Trelona part of RtB, see Trelona fine sandy loam.	6–11	Sandy clay loam	CL	A–6
	11–39	Very fine sandy loam	ML or CL	A–4
	39	Sandstone.		
Satanta:				
Fine sandy loam: SaA.	0–7	Fine sandy loam	SM or SC	A–4
	7–60	Loam	CL	A–6
Loam: StA, StB, StC, StD.	0–60	Loam, clay loam	CL	A–6
Shingle.	0–12	Loam to clay loam	CL	A–6
	12	Shale.		
Tassel.	0–8	Fine sandy loam	SM or SC	A–4
	8	Sandstone.		
Trelona:				
Loamy fine sand.	0–4	Loamy fine sand	SM	A–2
	4–12	Fine sandy loam	SM or SC	A–4
	12	Sandstone.		
Fine sandy loam.	0–12	Fine sandy loam	SM or SC	A–4
	12	Sandstone.		
Ulysses: UlA, UlB, UlC.	0–60	Loam	ML or CL	A–4
Valentine: Vh, Vr.	0–60	Fine sand	SP	A–3
For Dwyer part, see Dwyer fine sand.				
Vetal:				
Fine sandy loam: VtB.	0–60	Fine sandy loam	SM	A–4
Loamy fine sand.	0–10	Loamy fine sand	SM	A–2
	10–60	Fine sandy loam	SM	A–4
Weld.	0–4	Loam	ML	A–4
	4–26	Clay loam	CL	A–7
	26–60	Loam	ML	A–4

properties of the soils—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	*In./hr.*	*In./in. of soil*	*pH*		
100	100	20–35	>6.3	.08	6.6–7.3	Low	Low.
100	100	50–65	0.63–2.0	.17	6.6–7.3	Low	Moderate.
100	100	50–65	0.63–2.0	.17	7.9–8.4	Low	Low.
100	100	35–50	2.0–6.3	.13	6.6–7.3	Low	Low.
100	100	50–65	0.63–2.0	.17	6.6–7.3	Low	Moderate.
100	100	50–65	0.63–2.0	.17	7.9–8.4	Low	Low.
100	100	50–65	0.63–2.0	.17	6.6–7.3	Low	Low.
100	100	50–65	0.63–2.0	.17	6.6–7.3	Low	Moderate.
100	100	50–65	0.63–2.0	.17	7.9–8.4	Low	Low.
100	100	35–50	2.0–6.3	.13	7.4–7.8	Low	Low.
100	100	50–65	0.63–2.0	.17	7.4–9.0	Moderate	Low to moderate.
100	100	50–65	0.63–2.0	.17	7.4–9.0	Moderate	Low to moderate.
100	100	65–80	0.63–2.0	.17	7.9–8.4	Moderate	Moderate.
100	90–100	35–50	2.0–6.3	.13	7.9–8.4	Low	Low.
100	100	20–35	>6.3	.08	6.6–7.3	Low	Low.
100	90–100	35–50	2.0–6.3	.13	6.6–7.3	Low	Low.
100	90–100	35–50	2.0–6.3	.13	6.6–7.3	Low	Low.
100	100	65–80	0.63–2.0	.17	7.4–8.4	Low	Low.
100	100	4–12	>6.3	.06	6.6–7.3	Low	Low.
100	100	35–50	2.0–6.3	.13	7.4–8.4	Low	Low.
100	100	20–35	>6.3	.08	7.4–7.8	Low	Low.
100	100	35–50	2.0–6.3	.13	7.4–8.4	Low	Low.
100	100	70–85	0.63–2.0	.17	6.6–7.3	Low	Low.
100	100	80–95	0.63–2.0	.17	7.4–7.8	Low	Moderate.
100	100	75–90	0.63–2.0	.17	7.9–8.4	Moderate	Low.

TABLE 5.—*Engineering*

[Interpretations for Badlands, Gullied land, Rock land, and Rock outcrop are

Soil series and map symbols	Suitability as a source of—			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas
Alkali and saline land: Ak	Unsuitable	Unsuitable	Poor	Unstable soil; highly susceptible to frost heaving.	Poor stability	Moderate to rapid permeability.
Anselmo: AlB, AmA, AmB, AmC, AmD, AsA, AsC, AsD, AtA. For Dwyer part of AmA, AmB, AmC, and AmD, see Dwyer series. For Shingle part of AsA, AsC, and AsD, see Shingle series. For Trelona part of AtA see Trelona series.	Good	Unsuitable	Fair	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderately rapid permeability.
Ascalon: AuB, AuC	Good	Possible source below a depth of 6 feet.	Fair	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderate permeability.
Bankard: BfA, BfB	Poor	Possible source below a depth of 1 to 4 feet.	Good to very good.	Loose sand hinders hauling.	Fair to poor stability; high piping hazard.	Rapid permeability.
Bayard: BgB, BoA, BoB For Otero part of BoA and BoB, see Otero series.	Good	Unsuitable	Fair	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderately rapid permeability.
Bordeaux: BrA, BrB, BrC	Good	Unsuitable	Fair	Moderately to highly susceptible to frost heaving.	Fair to poor stability; high piping hazard.	Moderate permeability.
Chappell: ChB, ChC, ClD For Hawksprings part of ChB and ChC, see Hawksprings series. For Dix part of ClD, see Dix series.	Surface layer good.	Possible source below a depth of 40 inches.	Fair	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Pervious substratum.
Colby: CoC, CoD, CtC For Tassel part of CtC, see Tassel series.	Fair	Unsuitable	Fair	Highly susceptible to frost heaving.	Poor stability; high piping hazard.	Moderate permeability.

interpretations

not given, because the soil material is too variable for reliable evaluation]

Soil features affecting—Continued						Degree and kind of soil limitation for sewage disposal fields—	
Farm ponds—Continued: Embankments	Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building foundations [1]	Septic tanks and tile systems	Sewage lagoons
Poor stability..	Seasonal high water table; moderate to high corrosion potential.	Moderate to high alkali and salt accumulation.	Highly erodible.	Highly erodible; difficult to vegetate.	Poor bearing capacity.	Moderate: seasonal high water table.	Moderate to severe: moderate to rapid permeability.
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible.	Moderately erodible; moderate available water capacity.	Good bearing capacity.	Slight where the slope is less than 5 percent; moderate where the slope is 5 to 10 percent; severe where the slope is more than 10 percent.	Severe: moderately rapid permeability.
Fair stability; high piping hazard.	Well drained...	Moderate permeability; moderate available water capacity.	Moderately erodible.	Moderately erodible; moderate available water capacity.	Good bearing capacity.	Slight where the slope is less than 5 percent; moderate where the slope is 5 to 10 percent.	Severe: moderate permeability.
Fair to poor stability; high piping hazard.	Excessively drained.	Rapid permeability; low available water capacity.	Highly erodible.	Highly erodible; low available water capacity.	Good bearing capacity.	Slight. Severe in areas where pollution is a hazard.	Severe: rapid permeability.
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible.	Moderately erodible; moderate available water capacity.	Good bearing capacity.	Slight.....	Severe: moderately rapid permeability.
Fair to poor stability; high piping hazard.	Well drained...	Moderate permeability; moderate available water capacity.	Moderately erodible.	Moderately erodible; moderate available water capacity.	Fair to poor bearing capacity.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent.	Moderate on slopes of less than 7 percent; severe on slopes of more than 7 percent
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible surface layer; highly erodible substratum.	Moderately erodible; moderate available water capacity.	Good bearing capacity; substratum good if contained.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent; severe on slopes of more than 10 percent.	Severe: moderately rapid permeability.
Poor stability; high piping hazard.	Well drained...	Moderate permeability; high available water capacity.	Highly erodible.	Highly erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate on slopes of less than 10 percent; severe on slopes of more than 10 percent.	Moderate on slopes of less than 7 percent; severe on slopes of more than 7 percent.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas
Creighton: CvB, CvC, CvD	Good	Unsuitable	Fair	Moderately susceptible to frost heaving.	Poor to fair stability; high piping hazard.	Moderate permeability.
Dix: DcD, DcE	Unsuitable	Fair	Good	Highly erodible	Fair to poor stability; moderate to high piping hazard.	Rapid permeability.
Dunday: DdA, DdC, DeE, DfA, DfC. For Dwyer part of DdA, DdC, see Dwyer series. For Trelona part of DeE, see Trelona series. For Vetal part of DfA and DfC, see Vetal series.	Fair	Unsuitable	Good	Highly erodible	Fair stability; high piping hazard.	Rapid permeability.
Dune land: Dn	Unsuitable	Possible source of plaster sand; unsuitable for gravel.	Good if soil binder added.	Highly erodible	Rapid permeability when compacted.	Rapid permeability.
Duroc: DuA, DuB	Good	Unsuitable	Fair	Highly susceptible to frost heaving.	Poor stability; high piping hazard.	Moderate permeability.
Dwyer: DwA, DwC, DyD. For Mitchell part of DyD, see Mitchell series.	Poor to unsuitable.	Possible source of plaster sand in fine sand areas; unsuitable for gravel.	Good; may need soil binder.	Highly erodible	Fair to poor stability; high piping hazard.	Rapid permeability.
Epping: EpB, EpC, EpD	Fair	Unsuitable	Fair	Bedrock at a depth of 18 inches or less.	Poor stability; high piping hazard.	Bedrock at a depth of 18 inches or less.
Glenberg: GbA	Fair	Possible source below a depth of 6 feet.	Fair	Occasional flooding; moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderately rapid permeability.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of soil limitation for sewage disposal fields—	
Farm ponds—Continued: Embankments	Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building foundations [1]	Septic tanks and tile systems	Sewage lagoons
Poor to fair stability; high piping hazard.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Slight on slopes of less than 5 percent: moderate on slopes of 5 to 10 percent; severe on slopes of more than 10 percent.	Moderate on slopes of less than 10 percent; severe on slopes of more than 10 percent.
Fair to poor stability; moderate to high piping hazard.	Well drained to excessively drained.	Rapid permeability; low available water capacity.	Highly erodible; rapid permeability.	Highly erodible; low available water capacity.	Good bearing capacity if confined.	Moderate on slopes of less than 10 percent; severe on slopes of more than 10 percent.	Severe: rapid permeability.
Fair stability; high piping hazard.	Excessively drained.	Rapid permeability; low available water capacity.	Highly erodible; rapid permeability.	Highly erodible; low available water capacity.	Good bearing capacity.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent; severe on slopes of more than 10 percent.	Severe: rapid permeability.
Poor stability; rapid permeability when compacted.	Excessively drained.	Rapid permeability; low available water capacity.	Highly erodible; rapid permeability.	Highly erodible; low available water capacity.	Good bearing capacity if confined.	Moderate to severe due to slope.	Severe: rapid permeability.
Poor stability; high piping hazard.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Fair to poor stability; high piping hazard.	Excessively drained.	Rapid permeability; low available water capacity.	Highly erodible; rapid permeability.	Highly erodible; low available water capacity.	Good bearing capacity; fine sand areas require confinement.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent; severe on slopes of more than 10 percent.	Severe: rapid permeability.
Poor stability; high piping hazard.	Well drained...	Bedrock at a depth of 18 inches or less.	Highly erodible; bedrock at a depth of 18 inches or less.	Bedrock at a depth of 18 inches or less.	Bedrock at a depth of 18 inches of less.	Severe: bedrock at a depth of 18 inches or less.	Severe: bedrock at a depth of 18 inches or less.
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible; moderately rapid permeability.	Moderately erodible; moderate available water capacity.	Good bearing capacity.	Moderate to severe: occasional flooding.	Severe: moderately rapid permeability.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas
Goshen: GkA. For Kuma part, see Kuma series.	Good	Unsuitable	Fair to poor	Moderately to highly susceptible to frost heaving.	Poor stability; high piping hazard in surface layer and substratum.	Moderate permeability.
Hargreave	Good	Unsuitable	Fair to poor	Moderately susceptible to frost heaving.	Fair stability; low piping hazard in subsoil.	Moderate permeability; bedrock at a depth of 20 to 40 inches.
Haverson: HaA, HgA, HnA. For McCook part of HnA, see McCook series.	Good	Possible source below a depth of 6 feet.	Fair	Highly susceptible to frost heaving.	Poor stability; high piping hazard.	Moderate permeability.
Hawksprings	Good	Possible source below a depth of 40 inches.	Upper 36 inches fair; below a depth of 36 inches very good.	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderately rapid permeability.
Heldt: HtA	Poor	Unsuitable	Very poor	High shrink-swell potential.	Fair to poor stability; low piping hazard.	Moderately slow permeability.
Keith: KeA, KeB, KeC	Good	Unsuitable	Fair to poor	Moderately to highly susceptible to frost heaving.	High piping hazard in surface layer and substratum.	Moderate permeability.
Keota: KoA, KoB, KpD. For Epping part of KpD, see Epping series.	Fair	Unsuitable	Fair	Highly susceptible to frost heaving.	Poor stability; high piping hazard.	Moderate permeability; bedrock at a depth of 20 to 40 inches.
Kim: KyA, KyB, KyC	Poor	Unsuitable	Very poor	High shrink-swell potential.	Fair to poor stability; low piping hazard.	Moderately slow permeability.
Kuma	Good	Unsuitable	Fair to poor	Highly susceptible to frost heaving.	High piping hazard in surface layer and substratum.	Moderate permeability.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of soil limitation for sewage disposal fields—	
Farm ponds—Continued							
Embankments	Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building foundations [1]	Septic tanks and tile systems	Sewage lagoons
Poor stability; high piping hazard in surface layer and substratum.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Fair stability; low piping hazard in subsoil.	Well drained...	Moderate permeability; moderate available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; moderate available water capacity.	Fair to poor bearing capacity; bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to to 40 inches.
Poor stability; high piping hazard.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible; moderately rapid permeability.	Moderately erodible; moderate available water capacity.	Good bearing capacity; substratum requires confinement.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent.	Severe: moderately rapid permeability.
Fair to poor stability; low piping hazard.	Well drained...	Moderately slow permeability; high available water capacity.	Moderately erodible; moderately slow permeability.	Moderately erodible; high available water capacity.	Fair bearing capacity; high shrink-swell potential; poor shear strength.	Severe: moderately slow permeability.	Slight: moderately slow permeability.
High piping hazard in surface layer and substratum.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Poor stability; high piping hazard.	Well drained...	Moderate permeability; moderate available water capacity.	Highly erodible; moderate permeability.	Highly erodible; moderate available water capacity.	Poor bearing capacity; bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.
Fair to poor stability; low piping hazard.	Well drained...	Moderately slow permeability; high available water capacity.	Moderately erodible; moderately slow permeability.	Moderately erodible; high available water capacity.	Fair bearing capacity; high shrink-swell potential.	Severe: moderately slow permeability.	Slight: moderately slow permeability.
High piping hazard in surface layer and substratum.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity; moderate shrink-swell potential in subsoil.	Moderate: moderate permeability.	Moderate: moderate permeability.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas
Marsh and Wet land: MaB	Poor to fair	Possible source on bottom lands, below a depth of 4 to 6 feet.	Poor to good	Moderately to highly susceptible to frost heaving; water table frequently high.	Fair to poor stability; high piping hazard.	Water table frequently high.
Manter: MeA, MeB, MeC. For Anselmo part of MeA, MeB; and MeC, see Anselmo series.	Good	Unsuitable	Fair	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderately rapid permeability.
McCook	Good	Possible source below a depth of 6 feet.	Fair	Highly susceptible to frost heaving.	Poor stability; high piping hazard.	Moderate permeability.
Mitchell: MsA, MsC, MtA MtB, MtC, MtD. For Shingle part of MsA and MsC see Shingle series.	Fair	Unsuitable	Fair	Highly susceptible to frost heaving.	Poor stability; high piping hazard.	Moderate permeability.
Mixed alluvial land: Mu	Unsuitable	Good to fair source of sand; good source of gravel.	Good to very good.	Loose sand may hinder hauling.	Poor stability; high piping hazard.	Rapid permeability.
Norka: NoA, NoB, NrB, NwB, NwC. For Colby part of NrB, see Colby series. For Weld part of NwB and NwC, see Weld series.	Good	Unsuitable	Fair to poor	Moderately to highly susceptible to frost heaving.	High piping hazard in surface layer and substratum.	Moderate permeability.
Orella: OcA, OeD. For Epping part of OeD, see Epping series.	Unsuitable	Unsuitable	Very poor	Poor stability	Poor stability; low piping hazard.	Slow permeability.
Otero: OtA, OtB OtC	Fair	Unsuitable	Fair	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderately rapid permeability.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of soil limitation for sewage disposal fields—	
Farm ponds—Continued Embankments	Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building foundations [1]	Septic tanks and tile systems	Sewage lagoons
Fair to poor stability; high piping hazard.	Water table frequently high; outlets not available in all places.	Water table frequently high.	Moderately to highly erodible; moderate to rapid permeability.	Moderately to highly erodible; water table frequently high.	Water table frequently high.	Severe: water table frequently high.	Moderate to severe: moderate to rapid permeability.
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible; moderately rapid permeability.	Moderately erodible; moderate available water capacity.	Good bearing capacity.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent.	Severe: moderately rapid permeability.
Poor stability; high piping hazard.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Poor stability; high piping hazard.	Well drained...	Moderate permeability; high available water capacity.	Highly erodible; moderate permeability.	Highly erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate on slopes of less than 10 percent; severe on slopes of more than 10 percent.	Moderate on slopes of less than 7 percent; severe on slopes of more than 7 percent.
Poor stability; high piping hazard.	Excessively drained.	Rapid permeability; low available water capacity.	Highly erodible; rapid permeability.	Highly erodible; low available water capacity.	Good bearing capacity if confined.	Slight. Severe in areas where pollution is a hazard.	Severe: rapid permeability.
High piping hazard in surface layer and substratum.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Poor stability; low piping hazard.	Well drained...	Slow permeability; soft shale at a depth of 18 inches or less.	Moderately erodible; slow permeability.	Slow permeability; soft shale at a depth of 18 inches or less.	Fair bearing capacity; high shrink-swell potential.	Severe: slow permeability; soft shale at a depth of 18 inches or less.	Slight: slow permeability; underlying impervious shale.
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible; moderately rapid permeability.	Moderately erodible; moderate available water capacity.	Good bearing capacity.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent.	Severe: moderately rapid permeability.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas
Rosebud: ReA, ReC, RhB, RhC, RnA, RnB, RnC, RsA, RtB, RuB, RuC, RuD. For Dunday and Trelona parts of ReA and ReC, see Dunday and Trelona series. For Hargreave part of RhB and RhC, see Hargreave series. For Norka part of RnA; RnB and RnC, see Norka series. For Satanta part of RsA, see Satanta series. For Trelona part of RtB, RuB, RuC, and RuD, see Trelona series.	Good	Unsuitable	Fair	Moderately to highly susceptible to frost heaving.	Fair stability; low piping hazard in subsoil.	Moderate permeability; bedrock at a depth of 20 to 40 inches.
Satanta: SaA, StA, StB, StC, StD.	Good	Unsuitable	Fair	Moderately to highly susceptible to to frost heaving.	High piping hazard in surface layer and substratum.	Moderate permeability.
Shingle	Poor	Unsuitable	Poor	Bedrock at a depth of 18 inches or less.	Fair to good stability; low piping hazard.	Bedrock at a depth of 18 inches or less.
Tassel	Poor	Unsuitable	Fair	Bedrock at a depth of 18 inches or less.	Fair stability; high piping hazard.	Bedrock at a depth of 18 inches or less.
Trelona	Fair	Unsuitable	Fair	Bedrock at a depth of 18 inches or less.	Fair stability; high piping hazard.	Bedrock at a depth of 18 inches or less.
Ulysses: UlA, UlB, UlC	Good	Unsuitable	Fair	Highly susceptible to frost heaving.	Poor stability; high piping hazard.	Moderate permeability.
Valentine: Vh, Vr. For Dwyer part, see Dwyer series.	Unsuitable	Possible source of plaster sand; unsuitable source of gravel.	Good if soil binder added.	Loose sand hinders hauling.	Poor stability; rapid permeability when compacted.	Rapid permeability.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of soil limitation for sewage disposal fields—	
Farm ponds—Continued Embankments	Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building foundations[1]	Septic tanks and tile systems	Sewage lagoons
Fair stability; low piping hazard in subsoil.	Well drained...	Moderate permeability; moderate available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; moderate available water capacity.	Fair to poor bearing capacity.	Severe: bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.
High piping hazard in surface layer and substratum.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate on slopes of less than 7 percent; severe on slopes of more than 7 percent.
Fair to good stability; low piping hazard.	Well drained...	Bedrock at a depth of 18 inches or less.	Moderately erodible; bedrock at a depth of 18 inches or less.	Bedrock at a depth of 18 inches or less.	Fair bearing capacity; moderate shrink-swell potential.	Severe: bedrock at a depth of 18 inches or less.	Severe: bedrock at a depth of 18 inches or less.
Fair stability; high piping hazard.	Well drained...	Bedrock at a depth of 18 inches or or less.	Highly erodible; bedrock at a depth of 18 inches or less.	Bedrock at a depth of 18 inches or less.	Good bearing capacity; bedrock at a depth of 18 inches or less.	Severe: bedrock at a depth of 18 inches or less.	Severe: bedrock at a depth of 18 inches or less.
Fair stability; high piping hazard.	Well drained...	Bedrock at a depth of 18 inches or less.	Moderately erodible; bedrock at a depth of 18 inches or less.	Bedrock at a depth of 18 inches of less.	Good bearing capacity; bedrock at a depth of 18 inches or less.	Severe: bedrock at a depth of 18 inches or less.	Severe: bedrock at a depth of 18 inches or less.
Poor stability; high piping hazard.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.
Poor stability; rapid permeability when compacted.	Excessively drained.	Rapid permeability; low available water capacity.	Highly erodible; rapid permeability.	Highly erodible; low available water capacity.	Good bearing capacity if confined.	Slight on slopes of less than 5 percent; moderate on slopes of 5 to 10 percent; severe on slopes of more than 10 percent.	Severe: rapid permeability.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway location	Dikes and levees	Farm ponds: Reservoir areas
Vetal: VtB	Good	Possible source on stream terraces below a depth of 6 feet.	Fair	Moderately susceptible to frost heaving.	Fair stability; high piping hazard.	Moderately rapid permeability.
Weld	Good	Unsuitable	Fair to poor	Moderately to highly susceptible to frost heaving.	High piping hazard in surface layer and substratum.	Moderate permeability.

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

Orella: soft shale is at a depth of 8 to 20 inches.

Hargreave and Rosebud: soft sandstone is at a depth of 20 to 40 inches.

Tassel: soft sandstone is at a depth of 6 to 20 inches.

Trelona: soft sandstone is at a depth of 8 to 20 inches.

Keota: soft siltstone is at a depth of 20 to 40 inches.

Epping: soft siltstone is at a depth of 5 to 18 inches.

Shingle: soft shale or sandstone is at a depth of 8 to 20 inches.

Permeability refers to the movement of water downward through undisturbed material. The estimates are based on structure and porosity of the soil as it occurs in place.

Available water capacity, as used in this survey, refers to the amount of water needed to saturate the soil when moisture is at about the lowest point to which it can be reduced by growing crops. When moisture is at this point in the soil, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Reaction, which is represented by the pH value, indicates the degree of acidity or alkalinity of the soil solution and the protection needed for structures, such as pipelines, when placed in the soil.

Dispersion refers to the degree that soil particles smaller than 0.005 millimeter are separate or dispersed. Dispersion excludes the single grain or unaggregated condition common in clean sand. Dispersed soils often slick over when wet and crust over when dry. They are unstable, and their use for engineering purposes is hazardous.

Shrink-swell potential is an indication of the volume change to be expected of the soil material as the moisture content changes. In general, soils that have a high shrink-swell potential present hazards to the maintenance of engineering structures constructed in, on, or with soil material.

Salinity and depth to seasonal high water table are significant for only a few soils in this Area, and for this reason, these properties are not given in the table. Salinity is based on the electrical conductivity of saturated soil extract. It affects suitability of a soil for crops and for use as construction material. It also affects corrosivity to other materials.

Engineering interpretations

Table 5 contains information useful to engineers and others who plan to use soil material in construction of highways, farm facilities, buildings, and sewage disposal systems. Undesirable features are emphasized, but very important desirable features are also given. The information in this table is based on the estimated engineering properties of the soils, as shown in table 4; on available test data, including those in table 6; and on field experience. While, strictly, the information applies only to soil depths indicated in table 4, it is reasonably reliable to depths of about 6 feet for most soils, and several more for some. In general, soil features were rated according to the severity of the problems they might cause during the construction and maintenance of engineering structures.

Ratings are given for the suitability of soil material for topsoil and sand and gravel. Soils are rated poor or fair as a source of topsoil if they are low in content of organic matter or natural fertility or have a heavy and sticky surface layer that is difficult to handle or work. Soils rated as sources of sand or gravel may require extensive probing to find suitable material.

Ratings are also given for the suitability of soil material for road fill. In addition, the main soil features that affect use of the soils for various engineering applications are shown.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of soil limitation for sewage disposal fields—	
Farm ponds—Continued Embankments	Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building foundations [1]	Septic tanks and tile systems	Sewage lagoons
Fair stability; high piping hazard.	Well drained...	Moderately rapid permeability; moderate available water capacity.	Moderately erodible; moderately rapid permeability.	Moderately erodible; moderate available water capacity.	Good bearing capacity.	Slight: moderately rapid permeability.	Severe: moderately rapid permeability.
High piping hazard in surface layer and substratum.	Well drained...	Moderate permeability; high available water capacity.	Moderately erodible; moderate permeability.	Moderately erodible; high available water capacity.	Fair to poor bearing capacity; moderate shrink-swell potential in subsoil.	Moderate: moderate permeability.	Moderate: moderate permeability.

Engineering test data

Table 6 gives test data for samples of several different soils. Selected layers were sampled, and the samples were tested by the Bureau of Public Roads and the Wyoming State Highway Department. The soils tested were sampled at only one location, and variations in properties can be expected from samples taken at other locations.

Formation and Classification of the Soils

This section discusses the major factors of soil formation as they relate to the soils of Goshen County, Southern Part, and the system of classifying soils into categories broader than the series. The last part discusses the physical and chemical analyses of selected soils.

Factors of Soil Formation

The properties of the soil at any given place result from the integrated effects of five major factors of soil formation: parent material, climate, plant and animal life, relief, and time.

Few generalizations can be made regarding the effect of any one factor because the effect of each is modified by the other four.

Parent material

The soils of this Survey Area developed in three main kinds of parent material: residuum, eolian deposits, and alluvium. The nature of this material is related to the geological formation from which it was derived.

During early geological time, the southern part of Goshen County was covered by the sea from time to time. Each cycle of inundation and recession was accompanied by a period of deposition and erosion. Groups of sedimentary rock formed and in time covered the basal Precambrian rock to a depth of several thousand feet. During Cretaceous time, the uplift that created the Hartville Hills tilted these sedimentary beds steeply upward toward the west *(5, 6)*. Subsequent cycles of deposition and erosion produced the sedimentary rock of the Lance, Chadron, Brule, and Arikaree Formations. In more recent time, deposition and erosion formed the present topography, leaving eolian and alluvial deposits and re-exposing parts of these formations.

The Lance Formation consists of brown and gray, interbedded sandstone and shale. The shallow Shingle soils developed in this material. The sandstone weathers more rapidly than the shale; most of it has been reworked by wind and has become a part of the eolian deposits in the Goshen Hole Lowland.

The Chadron Formation consists of greenish-white clay shale and interbedded greenish-gray channel sandstone. The sandstone has left no residual material; it has probably become a part of the eolian deposits. Remnants of this sandstone are conspicuous as caprock on low buttes in the Goshen Hole Lowland. The shale has a high content of alkali earth carbonates. The shallow Orella soils developed in this material. It is slowly permeable and weathers slowly; it has contributed much material to the local alluvial deposits in the Goshen Hole Lowland.

The Brule Formation consists of pale-pink to white, blocky siltstone. The siltstone is soft and weathers rapidly. Geological erosion has removed the weathered material so rapidly that the only soils developing in it are shallow Epping soils and moderately deep Keota

TABLE 6.—*Engineering*

[Tests performed by the United States Department of Commerce, Bureau of Public Roads, and the Wyoming State Highway

Soil name, sample number, and location of sample	Parent material	Report No.	Depth from surface	Moisture-density data	
				Maximum dry density	Optimum moisture
			In.	*Lb./cu. ft.*	*Pct.*
Ascalon fine sandy loam:					
NW. corner, NW¼NW¼ sec. 4, T. 19 N., R. 63 W.	Old alluvium locally reworked by wind.	94310	0–6	107	15
		94311	10–30	114	15
		94312	40–60	112	14
Creighton very fine sandy loam:					
SE. corner, NE¼SE¼ sec. 19, T. 19 N., R. 63 W.	Soft sandstone.	94302	0–6	108	16
		94303	6–17	112	15
		94304	17–23	109	15
		94305	23–37	113	14
Dunday loamy fine sand:					
1,350 feet N. and 530 feet E. of the SW. corner, sec. 33, T. 26 N., R. 64 W.	Local alluvium and eolian sand.	[4]SCS 9	10–23	—	—
		[4]SCS 10	30–57	—	—
Heldt silty clay:					
517 feet E. and 187 feet N. of the east abutment of the Cherry Creek Bridge, SW¼SE¼SW¼ sec. 25, T. 24 N., R. 62 W.	Alluvium.	[4]SCS 1	6–24	—	—
		[4]SCS 2	24–41	—	—
		[4]SCS 3	48–70	—	—
Norka loam:					
150 feet SW. of the NE. corner, sec. 29, T. 19 N., R. 61 W.	Loess.	94285	0–2	99	20
		94286	2–8½	96	23
		94287	9½–12	96	23
		94288	12–60	104	18
Orella clay:					
319 feet E. and 105 feet N. of the SW. corner, sec. 20, T. 23 N., R. 61 W.	Soft shale.	SCS 7	5–12	—	—
		SCS 8	13–24	—	—
Rosebud very fine sandy loam:					
Near SE. corner SW¼SE¼ sec. 25, T. 19 N., R. 64 W.	Soft sandstone.	94295	0–3	110	14
		94296	3–17	108	18
		94297	21–30	111	16
		94298	30–41	111	14
Satanta loam:					
143 feet S. and 583 feet E. of the NW. corner, sec. 1, T. 22 N., R. 63 W.	Eolian sand and clay.	[4]SCS 4	9–32	—	—
		[4]SCS 5	32–57	—	—
		[4]SCS 6	57–70	—	—

[1] Analysis according to AASHO Designation: T 88–57*(1)*. Results by this procedure frequently differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming textural classes for soil.

test data

Department in accordance with standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis[1]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—							
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO	Unified[2]
							Pct.			
100	98	42	23	13	10	10	([3])	([3])	A–4 (1)	SM
100	96	40	26	18	16	15	25	6	A–4 (1)	SM–SC
100	97	44	25	14	11	11	([3])	([3])	A–4 (2)	SM
98	93	56	33	18	14	11	28	4	A–4 (4)	ML
98	92	53	35	21	15	12	28	5	A–4 (4)	ML
100	96	60	40	22	15	13	26	3	A–4 (5)	ML
100	96	55	35	20	14	12	25	4	A–4 (4)	ML–CL
100	97	23.2	28	11	9	7	([3])	([3])	A–2–4 (0)	SM
99	95	21.6	26	11	8	6	([3])	([3])	A–2–4 (0)	SM
100	100	98.8	83	53	53	45	67.6	38	A–7–5 (20)	CH
100	100	92.2	86	56	53	51	81.6	50	A–7–5 (20)	CH
100	100	94.9	85	56	43	31	51.2	21	A–7–5 (14)	MH
100	100	82	62	34	25	21	34	7	A–4 (8)	ML
100	100	90	75	48	37	32	45	20	A–7–6 (13)	CL
100	100	93	82	48	30	23	38	9	A–4 (8)	ML
100	100	92	79	40	22	17	31	7	A–4 (8)	ML
100	97	86.2	77	55	53	40	63.3	36	A–7–6 (20)	CH
100	99	69.7	80	56	48	35	74.5	41	A–7–5 (19)	CH or MH
99	95	36	24	15	12	11	24	3	A–4 (0)	SM
100	99	63	48	33	27	26	36	16	A–6 (8)	CL
100	99	61	45	29	21	18	27	6	A–4 (5)	ML or CL
99	97	48	32	20	16	14	23	3	A–4 (3)	SM
100	100	61.9	63	40	30	23	35.5	15	A–6 (7)	CL
100	97	51.3	50	34	25	19	29.6	11	A–6 (3)	CL
100	89	39.2	37	26	20	16	24.8	7	A–4 (1)	CL–ML or CL

[2] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. An example of a borderline classification so obtained is SM-SC.

[3] Nonplastic.

[4] Report numbers are those of the Wyoming State Highway Department.

soils. Most of the material weathered from the Brule Formation has become a part of the local alluvial and medium-textured eolian deposits in the Goshen Hole Lowland.

Harrison sandstone is the most important part of the Arikaree Formation. It is gray and soft and has small, pipy concretions. It is pervious and weathers rapidly. The deep Creighton soils, the moderately deep Rosebud and Hargreave soils, and the shallow Tassel and Trelona soils developed in this residual material. This formation has also contributed much material to local alluvial and eolian deposits.

The eolian deposits in this area are coarse textured, moderately coarse textured, and medium textured.

The coarse-textured deposits are low in clay content, are calcareous, and are rapidly permeable. Most of these deposits are derived from the Harrison sandstone and the Lance Formation. Some deposits that mantle terraces on the north side of the North Platte River are wind-reworked alluvium. Dunday, Dwyer, and Valentine soils developed in this material. They are deep but lack genetic horizons.

The moderately coarse textured eolian deposits are derived from the Lance Formation and the Chadron channel sandstone. The deep Anselmo, Manter, and Otero soils developed in these deposits.

The medium-textured eolian deposits consist of loess and locally derived material from the Brule Formation. Colby, Keith, Norka, Ulysses, and Weld soils developed in loess. Mitchell soils developed in medium-textured material derived from the Brule Formation.

The alluvial deposits are classified as general and local. General alluvium consists of the clay, silt, sand, and gravel deposited by perennial streams. It is generally stratified, and the strata vary considerably in thickness. Bankard, Glenberg, Haverson, and McCook soils developed on flood plains. They were influenced more by the parent material than by any other soil-forming factor. Ascalon soils developed in alluvium on high terraces. This alluvium has been in place long enough to have been influenced by all of the soil-forming factors.

Local alluvium occurs in swales and shallow drainageways, on fans and foot slopes, and on flood plains of some of the intermittent and small perennial streams. Generally, this material has been moved only a short distance from its source. It is generally uniform and unstratified and retains many characteristics of the original material. Dunday and Dwyer soils developed in coarse-textured alluvium. Bayard, Bordeaux, Chappell, Hawksprings, and Vetal soils developed in moderately coarse textured alluvium. Duroc, Goshen, Kuma, and Mitchell soils developed in medium-textured alluvium. Heldt and Kim soils developed in fine textured and moderately fine textured alluvium.

Climate

Climate has been an active force in the accumulation of parent material through the weathering of rocks, the transportation of unconsolidated material by streams, and the effect of wind and high-intensity rain. Relief, time, and parent material have modified the effect of the climate in this Area on such soil-forming processes as leaching and translocation of clay.

Many of the young soils, such as those of the Kim, Mitchell, and Otero series, have not been leached. Soils of the Duroc series have been leached because of their position on the landscape. All of the mature soils have been leached. Except for Hargreave soils, all have a zone of calcium carbonate accumulation. The depth to this zone ranges from about 9 to 40 inches, but averages 20 inches. This represents the extent of leaching and the depth to which most of the surface water percolated. Ascalon, Goshen, Keith, and Rosebud soils have a zone of clay accumulation. This accumulation results from the decomposition of clay minerals in place, the removal of clay from the surface layer by water, and the deposition of clay as the rate of percolation slows down. This zone is about 14 inches thick and occurs at a depth of about 6 inches.

Plant and animal life

The original vegetation in this Area was chiefly short, mid, and tall grasses. A few scattered shrubs and trees grew on the steep breaks. Keith, Norka, and Rosebud soils reflect the influence of grass vegetation. They have a dark-colored, granular, neutral to slightly alkaline surface layer. The activity of micro-organisms and earthworms was affected by local climatic conditions. Most of the Area was too dry to support earthworms.

Relief

Relief influences soil formation through its effect on runoff and drainage. Soil-forming processes are much slower on steep slopes than on gentle slopes. Runoff is rapid, and erosion is likely to remove soil material almost as fast as it forms. Most soils on steep slopes are immature, and those developing in residual material are generally shallow. Tassel and Trelona soils are typical of shallow, immature soils on steep slopes.

Well-drained swales and depressions receive runoff from higher lying slopes. This additional moisture promotes more vegetative growth and micro-organism activity and produces a satisfactory environment for earthworms. Duroc, Goshen, and Kuma soils, which are in swales and depressions, have a thicker A horizon and are more deeply leached than the soils that are developing in the same kind of parent material on adjoining slopes.

Time

A long time is needed for most soils to develop genetic horizons. The length of time varies with the climate, the vegetation, the parent material, and the relief. The old, or mature, soils in southern Goshen County have distinct horizons and accumulations of organic matter, clay, and calcium carbonate. Examples are the Ascalon, Goshen, Hargreave, Keith, Manter, Norka, Rosebud, Satanta, and Weld soils.

Young, or immature, soils either lack distinct horizons or have only one or two. In some, the only evidence of soil development is a slight darkening in the uppermost inch or more of the surface layer. Included in this group are Colby, Epping, Heldt, Keota, Kim, Mitchell, and Otero soils.

TABLE 7.—*Classification of soil series by higher categories*

Series	Family	Subgroup and great group	Order	Great soil group (1938 classification)
Anselmo	Coarse-loamy, mixed, mesic	Aridic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils
Ascalon	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils.
Bankard	Sandy, mixed, mesic	Ustic Torrifluvents	Entisols	Alluvial soils.
Bayard	Coarse-loamy, mixed, mesic	Torriorthentic Halpustolls	Mollisols	Regosols.
Bordeaux	Coarse-loamy, mixed, mesic	Torriorthentic Haplustolls	Mollisols	Regosols.
Chappell	Sandy, mixed, mesic	Aridic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Colby	Fine-silty, mixed, calcareous, mesic	Ustic Torriorthents	Entisols	Regosols.
Creighton	Coarse-loamy, mixed, mesic	Aridic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Dix	Sandy-skeletal, mixed, mesic	Torriorthentic Haplustolls	Mollisols	Regosols.
Dunday	Sandy, mixed, mesic	Torriorthentic Haplustolls	Mollisols	Regosols.
Duroc	Fine-silty, mixed, mesic	Aridic Pachic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Dwyer	Mixed, mesic	Ustic Torripsamments	Entisols	Regosols.
Epping	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols	Lithosols.
Glenberg	Coarse-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols	Alluvial soils.
Goshen	Fine-silty, mixed, mesic	Aridic Pachic Argiustolls	Mollisols	Chestnut soils.
Hargreave	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils.
Haverson	Fine-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols	Alluvial soils.
Hawksprings	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic.	AridicPachicHaplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Heldt	Fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols	Alluvial soils intergrading to Brown soils.
Keith	Fine-silty, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils.
Keota	Coarse-silty, mixed, calcareous, mesic	Ustic Torriorthents	Entisols	Regosols.
Kim	Fine-loamy, mixed, calcareous, mesic	Ustic Torriorthents	Entisols	Regosols.
Kuma	Fine-silty, mixed, mesic	Aridic Pachic Argiustolls	Mollisols	Chestnut soils.
Manter	Coarse-loamy, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils.
McCook	Fine-loamy, mixed, mesic	Torrifluventic Haplustolls	Mollisols	Alluvial soils.
Mitchell	Coarse-silty, mixed, calcareous, mesic	Ustic Torriorthents	Entisols	Regosols.
Norka	Fine-silty, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils.
Orella	Clayey, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols	Regosols.
Otero	Coarse-loamy, mixed, calcareous, mesic	Ustic Torriorthents	Entisols	Regosols.
Rosebud	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils.
Satanta	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils.
Shingle	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols	Lithosols.
Tassel	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols	Lithosols.
Trelona	Loamy, mixed, mesic, shallow	Torriorthentic Haplustolls	Mollisols	Lithosols.
Ulysses	Fine-silty, mixed mesic	Aridic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Valentine	Mixed, mesic	Ustic Torripsamments	Entisols	Regosols.
Vetal	Coarse-loamy, mixed, mesic	Aridic Pachic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Weld	Fine, montmorillonitic, mesic	Abruptic Aridic Paleustolls	Mollisols	Chestnut soils.

Other young soils, for example, Anselmo, Bayard, Bordeaux, Chappell, Creighton, Duroc, Hawksprings, McCook, Ulysses, and Vetal soils, have a dark-colored surface layer and accumulations of organic matter. Some have a thin zone of calcium carbonate accumulation but do not have a zone of clay accumulation.

The Bankard, Glenberg, and Haverson soils have not been in place long enough for genetic horizons to develop. Among the soils that are immature because of parent material or relief are Dunday, Dwyer, Orella, Shingle, Tassel, Trelona, and Valentine soils.

Classification of the Soils

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 *(2)* and later revised *(8)*. The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967 and September 1968 *(10)*. This system is under continual study, and readers interested in the development of the system should refer to the available literature.

Table 7 shows the classification of each of the soil series represented in the Survey Area according to the present system, and also the great soil group according to the 1938 system.

The current system defines classes in terms of observable or measurable properties of soils *(7)*. The properties chosen are primarily those that permit the grouping of soils that are similar in genesis. The classification is designed to encompass all soils. It has six categories. Beginning with the most inclusive, they are the order, the suborder, the great group, the subgroup, the family, and the series. These are briefly defined in the following paragraphs.

ORDER.—Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Three of the ten soil orders are represented in the Survey Area. They are Entisols, Aridisols, and Mollisols.

SUBORDER.—Each order is divided into suborders, primarily on the basis of characteristics that seem to produce classes having genetic similarity. Mainly, these are characteristics that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The climatic range is narrower than that of the orders.

GREAT GROUP.—Each suborder is divided into great groups, on the basis of uniformity in the kinds and sequence of major horizons and similarity of the significant features of corresponding horizons. The horizons considered are those in which clay, iron, or humus has accumulated and those that have pans that interfere with the growth of roots or the movement of water. The features selected are the self-mulching properties of clays, soil temperature, chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and other groups, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in instances where soil properties intergrade outside the range of any other great group, suborder, or order.

FAMILY.—Families are established within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils in engineering use. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

Physical and Chemical Analyses

Data obtained by physical and chemical analyses of selected soils in the southern part of Goshen County are given in table 8. These data are useful in classification of soils and in development of concepts of soil genesis. They are also useful in estimating water-holding capacity, erodibility, fertility, and tilth.

The samples used to obtain the data in table 8 were collected from carefully selected pits. Rock fragments larger than ¾ inch in diameter were discarded. The material passing the ¾-inch sieve was rolled, crushed, and sieved by hand to remove particles larger than 2 millimeters in diameter. All material passing the 2-millimeter sieve is reported on an ovendry basis.

Standard methods of the Soil Survey Laboratory *(11)* were used to obtain most of the data in table 8. The pipette method was used to determine the percentage of clay. A 77-percent recovery factor was used to determine the percentage of organic carbon after the soil was chemically treated by acid-dichromate digestion and titrated with ferrous sulfate. The calcium carbonate equivalent was determined by measuring the volume of carbon dioxide emitted from soil samples treated with concentrated hydrochloric acid. The cation-exchange capacity was determined by direct distillation of adsorbed ammonia. To determine the extractable calcium and magnesium, calcium was separated as calcium oxalate and magnesium as magnesium ammonium phosphate. Amounts of potassium and sodium were determined by using a flame spectrophotometer analysis. Exchangeable sodium and potassium are corrected values representing the differences between cations that were extracted by the ammonium acetate method minus the amounts that were soluble in the saturation extract.

General Nature of the Area

This section tells about the physiography, relief, and drainage in the southern part of Goshen County, the climate, the history and development, and the farming.

Physiography, Relief, and Drainage

The Survey Area is in the High Plains section of the Great Plains province. There are two subdivisions—the Western Nebraska and Eastern Wyoming Uplands and the Goshen Hole Lowland. These subdivisions are separated by an almost continuous escarpment that ranges from 400 to 700 feet in height.

The Western Nebraska and Eastern Wyoming Uplands consists of an undulating or gently rolling tableland and of rolling to steep hills. There is an area of these uplands west of Lingle and south of Fort Laramie. The eastern part is a gently rolling tableland. To the north, west, and southwest of the tableland, the area is dissected by steep, narrow valleys. The valleys drain into the North Platte River, the Laramie River, Six Mile Creek, Deer Creek and its tributaries, and Cherry Creek. The tableland is bordered on the east and south by a steep escarpment. It is 400 to 500 feet higher than the lowlands.

The uplands in the southwestern part of the Survey Area are bisected by Bear Creek valley. For the first 6 or 8 miles east of the Laramie County line, this valley is narrow and has rugged side slopes. Eastward, it gradually widens and has more gentle side slopes. It finally merges with the Goshen Hole Lowland.

The area north of Bear Creek consists of a broad, undulating tableland, rolling hills, and rugged Bear Mountain. The tableland is the eastward extension of a similar area in Platte County and is bordered on the north and northeast by a steep escarpment and on the south by the steep valley rims above Bear Creek. The hills are to the east and southeast of the tableland. They are broken by the steep escarpments around the head of Fox Creek but dip eastward to merge with Diamond Flat and the lower valley of Fox Creek. Part of this area is drained by Fox Creek. A small part drains into Bear Creek through narrow valleys that dissect the valley rim. The tableland is 500 to 800 feet higher than the lowlands to the north of the Goshen Hole rim. Most of it lacks a distinct drainage sytem.

The area south of Bear Creek consists of a relatively narrow tableland, bordering steep valley rims of Bear Creek on the west and northwest, and the strongly rolling hills on the east and northeast. Most of this area is drained by Bear Creek. The southeastern corner is drained by Four Mile Draw.

A small part of the Western Nebraska and Eastern Wyoming Uplands, consisting of steep dissected hills, cuts across the extreme southeastern corner of the Survey Area. Sixtysix Mountain, northeast of LaGrange, is also part of this upland.

The Goshen Hole Lowland is a great local widening of the North Platte Valley. It consists of the present stream valley and the Goshen Hole. Goshen Hole is an undulating to rolling plain that has gentle to moderately steep foot slopes along the base of the rim. The relief is broken by several buttes and outliers of the uplands. The most prominent butte in the western part is Red Bill Point, and in the eastern part, Table Mountain. The elevation ranges from about 4,700 to 4,045 feet. Red Bill Point has an elevation of 4,475 feet, Veteran 4,220 feet, LaGrange 4,587 feet, Yoder 4,231 feet, and Huntley 4,230 feet. The southern part of this area is drained by Horse Creek and its tributaries, the northern part by Cherry Creek, and the northeastern part by Katzer Drain.

The valley along the North Platte River consists of stream bottoms bordered by stream terraces and foot slopes. The stream bottoms are 4 to 12 feet above the river channel and range in width from a few hundred feet to about 2 miles. In many places the terraces are indistinct, especially south of the river. The stream bottoms merge with the foot slopes that grade into the uplands and Goshen Hole. The terraces are more distinct north of the river; one of the most prominent is above Torrington. This terrace has a well-developed frontal escarpment and is mantled by eolian sand. In some places this mantle is fairly smooth, but east of Torrington it is thick and is typically sand hills topography. The North Platte River enters the Survey Area at an elevation of 4,275 feet. The lowest elevation, 4,025 feet, occurs where the river enters Nebraska.

Climate [8]

The climate in the Survey Area is semiarid. The high elevation and the dry air cause wide variations in temperature between summer and winter and between daily maximums and minimums. Freezing temperatures late in spring and early in fall are not uncommon.

The Survey Area lies along the eastern border of Wyoming, in the southeastern part of the State. The North Platte River flows east-southeast through the Area. The river valley is broad in most places and has low-level benches rising to either side for several miles. Horse Creek flows easterly across the southern part of the Area, northerly to near the center, and then easterly out of the State.

The Laramie Range has an appreciable effect on the climate. It is about 55 miles west of Torrington, extends in a north-south direction, and is about 9,000 feet high. The terrain gradually slopes upward to the west for the first 45 miles and then rises abruptly into the range. The predominantly westerly winds moving downslope warm the air as it is compressed at the lower elevation. Cold air is seldom trapped because it tends to move to the east, in the direction of the prevailing winds.

The coldest temperatures occur with outbreaks of cold air from Canada. There are no mountains to the north to block passage of cold air masses from Canada southward; the Black Hills are about 100 miles to the north but have no appreciable effect on the climate. Thus, the Area is subject to wide and sometimes abrupt changes of weather. The outbreaks of cold air from Canada generally do not last long, because their path is generally southeasterly and then easterly. Consequently, the Survey Area is in the western edge of the cold air for only a limited time.

Table 9 gives temperature and precipitation data for four weather stations in the Survey Area (fig. 13). Table 10 shows probabilities of specified temperatures and amounts of precipation. Further probabilities

[8] By J. D. ALYEA, State climatologist, U.S. Weather Bureau, Department of Commerce.

TABLE 8.—*Analytical data*

[Analyses made at Soil Survey Laboratory,

Soil type, location of sample, sample number, and laboratory number	Depth from surface	Particle-size distribution					Reaction	
		Very coarse, coarse, and medium sand (2.0-0.25 mm.)	Fine sand (0.25-0.10 mm.)	Very fine sand (0.10-0.05 mm.)	Silt (0.05-0.002 mm.)	Clay <(0.002 mm.)	Saturated paste	1:10 suspension
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*pH*	*pH*
Hargreave very fine sandy loam:								
Location: 900 feet south of NW. corner of SW¼ sec. 36, T. 21 N., R. 64 W., and 200 feet east of road. Sample No. S-53-Wyo-8-7. Laboratory Nos. 1920 to 1925, inclusive.	0–2	20.5	21.4	33.6	9.3	15.2	5.8	7.1
	2–8	17.3	20.7	35.3	10.1	16.6	6.6	7.1
	8–12	9.0	20.9	37.0	8.5	24.6	6.6	7.2
	12–19	5.8	24.7	42.9	9.6	17.0	6.6	6.9
	19–28	6.6	27.2	43.5	9.3	13.4	6.8	7.0
	28–33	11.7	24.8	42.4	9.4	11.7	6.9	7.0
Heldt silty clay:								
Location: 517 feet east and 187 feet north of east abutment of bridge over Cherry Creek, SW¼SE¼SW¼ sec. 25, T. 24 N., R. 62 W. Sample No. S-64-Wyo-8-1. Laboratory Nos. 19415 to 19422, inclusive.	0–6	.2	.5	2.9	44.9	51.5	7.4	8.3
	6–16	.2	.3	1.5	48.7	49.3	7.4	8.5
	16–24	.2	.6	5.1	53.1	41.0	7.4	8.6
	24–33	.1	.3	2.4	53.8	43.4	7.5	8.8
	33–41	.1	.4	1.8	40.8	56.9	7.5	8.9
	41–48	.3	.7	3.8	40.8	54.4	7.5	8.8
	48–57	.1	.6	6.6	59.1	33.6	7.6	8.7
	57–70	.1	.5	5.1	58.8	35.5	7.3	8.7
Norka loam:								
Location: 185 feet west and 140 feet south of NE. corner of sec. 29, T. 19 N., R. 61 W. Sample No. S-64-Wyo-8-11. Laboratory Nos. 19462 to 19469, inclusive.	0–3	.6	5.5	40.9	36.3	16.7	(1)	(1)
	3–7	.6	3.9	37.5	30.1	27.9	(1)	(1)
	7–12	.4	2.3	26.4	43.8	27.1	(1)	(1)
	12–19	.7	3.9	30.9	54.5	10.0	(1)	(1)
	19–30	.3	2.3	34.6	54.7	8.1	(1)	(1)
	30–40	.3	2.1	32.4	53.2	12.0	8.0	(1)
	40–50	.3	2.3	32.9	53.0	11.5	(1)	(1)
	50–62	.2	2.7	34.3	51.6	11.2	8.1	(1)
Orella clay:								
Location: 319 feet east and 105 feet north of SW. corner, sec. 20, T. 23 N., R. 61 W. Sample No. S-64-Wyo-8-6. Laboratory Nos. 19494 to 19495, inclusive.	0–4	7.2	5.9	9.3	36.7	40.9	7.8	9.2
	4–12	3.4	3.5	5.6	46.8	40.7	8.0	9.4
Satanta loam:								
Location: 143 feet south and 583 feet east of NW. corner of sec. 1, T. 22 N., R. 63 W. Sample No. S-64-Wyo-8-5. Laboratory Nos. 19483 to 19490, inclusive.	0–5	11.5	16.0	24.5	25.1	22.9	(1)	(1)
	5–9	13.4	17.8	22.9	18.3	27.6	(1)	(1)
	9–19	8.1	13.9	25.4	26.8	25.8	(1)	(1)
	19–32	3.6	12.0	32.7	29.5	22.2	(1)	(1)
	32–44	6.3	18.9	29.7	24.6	20.5	7.8	(1)
	44–57	15.0	20.9	25.0	18.7	20.4	(1)	(1)
	57–70	24.0	22.7	20.6	15.6	17.1	(1)	(1)
	70–90	31.9	22.8	17.2	12.0	16.1	7.9	(1)

[1] Values were not determined or do not apply.
[2] Trace.

for selected soil profiles

Soil Conservation Service, Lincoln, Nebraska]

Organic carbon	C/N ratio	$CaCO_3$ equivalent	Cation exchange capacity	Extractable cations		Exchangeable cations		Exchangeable sodium	Moisture held at—	
				Ca	Mg	Na	K		⅓ atmosphere	15 atmospheres
Percent		*Percent*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Percent*	*Percent*	*Percent*
0.72	(1)	(1)	15.4	11.4	2.8	0.2	1.2	1	14.6	7.1
.72	(1)	(1)	15.3	11.6	2.8	.2	.9	1	17.3	7.7
.54	(1)	(1)	21.9	17.2	4.2	.4	1.2	2	23.9	11.9
.26	(1)	(1)	18.5	16.2	3.7	.2	.8	1	15.4	8.5
.16	(1)	(1)	16.4	12.6	2.9	.2	.8	1	13.0	7.0
.13	(1)	(1)	15.6	12.4	2.6	.2	.8	1	13.0	6.5
1.83	12.0	6	43.8	38.5	7.0	.5	4.0	1	43.1	25.6
.62	10.0	10	42.5	37.9	6.4	1.2	3.3	2	42.4	25.6
.48	10.0	10	36.2	32.3	6.8	1.7	2.6	4	37.9	21.6
.47	(1)	10	39.6	33.7	7.7	3.8	2.9	8	42.0	25.3
.41	(1)	8	44.0	35.9	7.9	6.3	3.3	12	45.8	28.3
.46	(1)	7	44.3	34.6	8.6	7.4	3.4	12	(1)	28.0
.45	(1)	8	36.2	31.0	5.5	6.3	3.0	13	39.9	22.9
.34	(1)	8	40.2	31.7	6.4	4.6	3.1	9	41.1	23.9
2.17	(1)	(1)	18.8	16.0	2.7	(2)	1.5	(1)	30.2	9.5
1.32	(1)	(2)	23.5	22.0	3.3	(2)	1.8	(1)	35.3	11.6
1.06	(1)	1	28.6	22.3	5.4	.1	2.2	(1)	31.6	13.2
.70	(1)	16	19.9	16.7	5.9	.1	2.1	(1)	33.1	13.3
.18	(1)	9	18.2	13.6	6.6	.1	2.3	(1)	26.2	9.5
.18	(1)	8	17.9	11.2	8.1	.4	2.6	2	30.6	9.4
.14	(1)	7	18.2	10.2	7.9	1.3	2.8	(1)	26.5	9.2
.11	(1)	6	18.2	10.0	7.2	2.0	2.6	10	32.5	8.7
.70	(1)	8	35.4	28.1	2.9	7.8	2.7	20	39.2	19.6
.35	(1)	6	42.4	25.0	3.9	14.9	2.6	32	40.3	26.9
1.52	10	(2)	21.3	16.9	2.0	(2)	1.9	(1)	31.3	10.0
1.04	9	1	23.1	19.2	2.7	(2)	2.3	(1)	28.2	11.6
.67	8	11	20.8	18.2	3.5	.2	2.0	(1)	25.7	11.9
.29	(1)	11	19.0	15.6	4.7	1.1	1.9	(1)	20.7	10.6
.12	(1)	10	17.9	12.4	5.1	2.7	1.8	13	18.9	9.1
.05	(1)	9	17.6	10.4	5.1	3.8	1.7	(1)	25.7	8.4
.02	(1)	7	15.5	8.7	3.7	4.2	1.4	(1)	23.0	6.9
.01	(1)	6	13.8	7.9	3.1	4.5	1.0	27	(1)	6.6

TABLE 9.—*Temperature and precipitation data for*

Month	Temperature							Mean heating degree days[1]	Precipitation
	Mean daily maximum	Mean daily minimum	Monthly mean	Record high	Year	Record low	Year		Mean total
	°F.	°F.	°F.	°F.		°F.			In.
LaGrange: (Elevation 4,587 feet. Data based on records 1937–64.)									
January	40.1	12.9	26.5	67	1953	—34	1963	1,200	0.49
February	43.8	16.5	30.2	79	1962	—32	1951	986	.48
March	48.5	21.5	35.0	82	1946	—25	1943	946	.89
April	60.8	31.0	45.9	86	[2]1962	— 7	1938	600	1.99
May	70.2	40.4	55.3	96	1939	16	1947	344	2.66
June	80.0	49.0	64.5	104	1954	27	1951	108	2.47
July	89.3	55.2	72.3	110	1939	35	[2]1952	12	1.68
August	88.1	54.1	71.1	103	1941	32	1964	22	1.44
September	78.9	43.9	61.4	99	1940	16	1942	171	1.41
October	67.4	33.6	50.5	91	1946	4	1952	499	1.22
November	51.4	22.1	36.8	78	[2]1946	—19	1952	849	.57
December	43.7	16.9	30.3	73	1939	—34	1964	1,135	.70
Year	63.5	33.1	48.3					6,872	16.00
Phillips: (Elevation 4,982 feet. Data based on records 1947–64.)									
January	40.1	15.1	27.6	69	1953	—27	1959	1,159	0.39
February	43.4	18.2	30.8	75	1962	—25	1951	958	.40
March	46.3	21.0	33.7	77	1953	—20	1960	970	.87
April	58.7	30.7	44.7	85	1960	5	1959	609	1.37
May	68.2	40.6	54.4	91	1954	18	1947	344	2.93
June	78.3	48.5	63.4	104	1954	28	[2]1954	126	2.63
July	86.7	54.3	70.5	105	1954	38	[2]1959	19	1.84
August	85.7	52.9	69.3	100	1949	34	[2]1962	22	1.10
September	77.1	43.6	60.4	98	[2]1960	18	1951	177	1.15
October	66.1	34.5	50 3	89	1958	10	1961	456	.78
November	50.3	23.7	37.0	77	[2]1954	—15	1952	840	.52
December	43.6	19.6	31.6	67	1959	—32	1964	1,035	.42
Year	62.0	33.6	47.8					6,715	14.40
Torrington Experiment Farm: (Elevation 4,098 feet. Data based on records 1931–60.)									
January	40.9	12.0	26.5	70	1953	—33	1942	1,194	0.28
February	44.5	14.9	29.7	75	1954	—33	1936	988	.39
March	50.1	21.2	35.7	85	1943	—26	1948	908	.76
April	61.5	30.7	46.1	87	[2]1960	—10	1936	567	1.80
May	70.8	41.2	56.0	100	1939	18	1947	279	2.55
June	81.2	50.1	65.7	105	1954	29	1951	93	2.75
July	89.3	55.9	72.6	107	1939	39	[2]1959	8	1.41
August	87.3	53.5	70.4	105	1960	35	[2]1932	15	.95
September	78.5	42.5	60.5	101	1960	17	[2]1942	180	1.01
October	67.3	31.7	49.5	92	1947	4	1935	481	.72
November	51.7	20.4	36.1	79	[2]1954	—20	1941	867	.47
December	43.8	14.9	29.4	77	1941	—29	1932	1,104	.43
Year	63.9	32.4	48.2					6,684	13.52
Yoder: (Elevation 4,231 feet. Data based on records 1936–64.)									
January	41.9	13.5	27.7	69	1953	—35	1963	1,178	0.28
February	44.7	15.1	29.9	79	1962	—32	[2]1962	983	.36
March	50.2	21.0	35.6	83	1943	—27	1948	911	.73
April	62.0	30.7	46.4	86	[2]1962	— 8	1936	558	1.78
May	71.3	40.0	55.7	95	1939	12	1947	316	2.41
June	81.7	48.9	65.3	105	1954	27	1951	96	2.49
July	90.8	54.9	72.9	108	1939	37	[2]1959	8	1.53
August	89.0	52.8	70.9	105	1937	32	1964	14	1.03
September	80.0	42.2	61.1	100	[2]1960	19	[2]1964	162	1.03
October	69.1	31.9	50.5	94	1953	6	1952	453	.78
November	52.3	21.2	36.8	82	1939	—28	1941	846	.42
December	44.7	16.6	30.7	76	1941	—33	1964	1,063	.37
Year	64.8	32.4	48.6					6,588	13.21

[1] Calculated from a base of 65° F. [2] Also occurred in earlier years. [3] Less than half a day.

four weather stations in Goshen County Survey Area

Precipitation—Con							Mean number of days with—				
		Snow and sleet					Precipitation of 0.10 inches or more	Maximum temperature of—		Minimum temperature of—	
Daily maximum	Year	Mean total	Monthly maximum	Year	Daily maximum	Year		90°F. and above	32°F. and below	32°F. and below	0°F. and below
In.		*In.*	*In.*		*In.*		*Days*	*Days*	*Days*	*Days*	*Days*
0.56	1939	7.0	20.5	1949	8.0	1949	2	0	8	29	6
.40	1953	6.6	17.8	1939	7.0	[2]1953	2	0	5	27	3
1.23	1961	10.5	27.7	1944	12.0	[2]1959	3	0	4	27	2
1.55	1964	6.0	30.0	1955	27.0	1955	4	0	1	17	(3)
2.00	1938	1.6	8.0	1947	8.0	1947	6	1	0	5	0
2.70	1947	.3	5.0	1947	5.0	1947	6	7	0	1	0
1.52	1956	.0	.0		.0		4	16	0	0	0
1.94	1945	.0	.0		.0		3	15	(3)	0	0
1.14	[2]1955	.2	3.0	1945	3.0	1945	3	5	0	3	0
1.28	1947	1.3	8.0	1946	6.0	1952	3	(3)	(3)	14	0
.82	1955	5.3	21.5	1956	6.5	1956	2	0	3	26	1
.79	1958	7.0	21.0	1945	7.0	1960	2	0	5	29	3
		45.8					40	44	26	178	15
0.40	1949	6.9	16.1	1949	9.0	1962	1	0	8	28	5
.49	1961	6.9	19.0	1953	9.0	1953	1	0	5	25	3
1.08	1961	12.2	24.5	1959	11.0	1963	3	0	4	28	2
1.07	1948	7.4	29.0	1955	18.0	[2]1964	4	0	1	18	0
2.10	1961	2.5	13.0	1961	8.0	[2]1961	6	(3)	(3)	4	0
1.96	1947	.6	7.0	1947	4.0	1947	6	4	0	(3)	0
1.46	1953	.0	.0		.0		5	13	0	0	0
1.41	1964	.0	.0		.0		3	10	0	0	0
1.17	1951	.3	3.0	1954	2.0	[2]1955	3	3	0	3	0
1.15	1947	2.0	7.0	1959	6.0	1961	2	0	(3)	13	0
.99	1955	6.8	19.7	1947	7.0	1953	2	0	4	24	1
.53	1958	7.0	13.5	1960	9.0	1960	1	0	5	28	2
		52.6					37	30	27	171	13
0.52	1944	4.6	14.7	1949	6.5	1952	1	0	7	30	6
.88	1953	5.9	20.5	1953	9.0	[2]1953	1	0	5	27	3
1.36	1946	7.5	22.5	1944	11.0	1949	2	0	3	28	2
2.64	1945	4.0	26.1	1945	7.0	1946	4	0	(3)	17	(3)
2.11	1955	.7	6.0	[2]1957	6.0	[2]1957	6	1	0	4	0
5.44	1955	.1	1.5	[2]1947	1.5	1937	5	7	0	(3)	0
2.00	1941	.0	.0		.0		3	16	0	0	0
1.28	1941	.0	.0		.0		3	13	0	0	0
1.06	1938	.0	.0		1.5	1945	3	4	0	3	0
.92	1949	.7	5.0	1959	4.0	1959	2	(3)	(3)	17	0
.54	1952	4.3	13.4	1947	6.5	1936	2	0	3	27	2
.70	1936	5.3	13.6	1945	6.0	[2]1960	1	0	6	30	1
		33.1					33	41	24	183	14
0.60	1939	5.2	23.0	1940	12.0	1949	1	0	8	29	6
.54	1948	4.7	12.0	1955	8.0	1945	1	0	5	27	3
1.21	1937	7.4	22.0	1944	12.0	1963	3	0	3	27	2
2.26	1945	4.8	14.0	1957	16.0	1945	4	0	(3)	17	(3)
2.40	1955	.9	10.0	1961	10.0	1961	5	1	0	5	0
2.74	1941	.3	5.0	1947	5.0	1947	6	7	0	(3)	0
3.00	1937	.0	.0		0.		4	19	0	0	0
1.40	1945	.0	.0		0.		2	16	0	(3)	0
1.30	1938	.2	4.0	1955	4.0	1955	3	5	0	4	0
1.10	1949	.8	7.0	1946	5.0	1961	2	(3)	(3)	17	0
.60	1955	3.9	14.5	1947	7.0	[2]1947	2	0	2	26	1
.65	1960	4.7	14.4	1958	6.0	[2]1960	1	0	5	29	3
		32.9					34	48	23	181	15

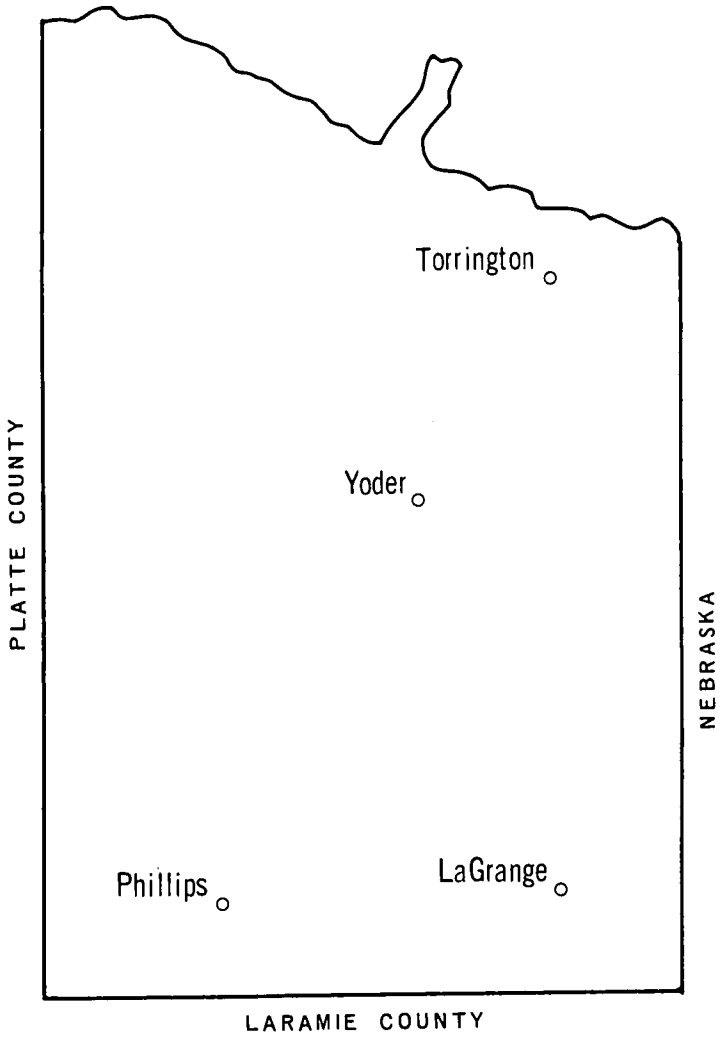

***Figure 13.*—Location of four weather stations in the Survey Area.**

are given in Bulletins 415 and 416 compiled at the University of Wyoming Agricultural Experiment Station *(3, 4)*. Table 11 shows the average dates for specified freezing temperatures. Table 12 gives data on evapotranspiration. Table 13 shows the probability, the amount, and the frequency of short duration maximim precipitation.

The average growing season from the last 32° F. temperature in spring to the first in fall is 120 days at LaGrange and 127 days at the Torrington Experiment Farm. The average growing season from the last 28° temperature in spring to the first in fall is 142 days at LaGrange and 148 days at the Torrington Experiment Farm.

Precipitation is lightest in December, January, and February and increases to a peak during the last part of May and the first part of June. It decreases rapidly during the last half of June, reaches a low by August, and then increases to a secondary peak about the middle of September. Generally about half the annual amount of precipitation falls between the dates of the last 32° temperature in spring and the first in fall,

TABLE 10.—*Probabilities of specified degrees of temperature and amounts of precipitation*

Month	Temperature		Precipitation	
	Two years in 10 will have at least 4 days with—		One year in 10 will have—	
	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Less than—	More than—
	°F.	°F.	In.	In.
LaGrange:				
January	58	—11	0.08	1.06
February	62	— 4	.04	.81
March	68	3	.39	1.84
April	78	18	.48	3.19
May	86	29	.78	4.87
June	95	39	.94	4.78
July	99	47	.58	3.16
August	98	44	.29	3.04
September	94	31	.08	2.24
October	83	22	.15	2.37
November	68	3	.07	1.36
December	60	— 3	.07	1.18
Phillips:				
January	59	— 9	.12	.08
February	62	— 2	.06	.72
March	65	2	.35	1.45
April	76	18	.67	2.62
May	84	30	.81	5.36
June	93	37	.90	5.33
July	97	47	.59	3.66
August	95	44	.30	2.09
September	92	33	.10	2.42
October	83	23	.14	1.99
November	68	7	.07	1.11
December	59	1	.15	.77
Torrington Experiment Farm:				
January	59	—11	.02	.74
February	64	— 6	.03	.81
March	70	2	.24	1.45
April	80	16	.70	3.95
May	87	30	.87	4.46
June	96	40	.78	6.39
July	99	49	.34	3.09
August	97	44	.29	1.90
September	92	31	.15	1.83
October	83	19	.08	1.62
November	69	3	.06	1.15
December	62	— 4	.05	.92
Yoder:				
January	59	—10	.04	.64
February	62	— 6	.02	.66
March	70	1	.18	1.61
April	79	16	.52	3.22
May	87	29	.71	4.52
June	97	39	1.02	5.20
July	100	47	.54	3.69
August	98	42	.24	2.25
September	93	30	.13	2.12
October	84	19	.18	1.74
November	70	4	(1)	1.00
December	61	— 3	(1)	.87

[1] Trace.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

Probability	Dates for given probability and temperature				
	16 °F. or lower	20 °F. or lower	24 °F. or lower	28 °F. or lower	32 °F. or lower
LaGrange—					
Spring:					
1 year in 10 later than	April 30	May 6	May 17	June 1	June 13
2 years in 10 later than	April 23	April 30	May 10	May 25	June 6
5 years in 10 later than	April 10	April 17	April 27	May 12	May 24
Fall:					
1 year in 10 earlier than	October 12	October 4	September 25	September 15	September 5
2 years in 10 earlier than	October 17	October 9	September 30	September 20	September 10
5 years in 10 earlier than	October 28	October 20	October 11	October 1	September 21
Torrington Experiment Farm—					
Spring:					
1 year in 10 later than	April 23	May 2	May 11	May 22	June 3
2 years in 10 later than	April 18	April 27	May 6	May 17	May 29
5 years in 10 later than	April 7	April 16	April 25	May 6	May 18
Fall:					
1 year in 10 earlier than	October 16	October 5	September 30	September 16	September 7
2 years in 10 earlier than	October 21	October 10	October 5	September 21	September 12
5 years in 10 earlier than	October 31	October 20	October 15	October 1	September 22

TABLE 12.—*Evapotranspiration and precipitation data*

Station	January	February	March	April	May	June	July	August	September	October	November	December	Year
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
LaGrange:													
Maximum potential evapotranspiration	0	0	0.22	1.33	2.84	4.27	5.55	4.94	3.12	1.57	0.32	0	24.16
Potential evapotranspiration (32 °F.) [1]	0	0	0	0	.64	4.27	5.55	4.94	2.18	0	0	0	17.58
Potential evapotranspiration (28 °F.) [2]	0	0	0	0	1.74	4.27	5.55	4.94	3.12	.05	0	0	19.67
Average precipitation minus potential evapotranspiration	+ .49	+ .48	+ .67	+ .66	— .18	—1.80	—3.87	—3.50	—1.71	— .35	+ .25	+ .70	— 8.16
Torrington Experiment Farm:													
Maximum potential evapotranspiration	0	0	.31	1.44	3.03	4.52	5.70	4.94	3.03	1.57	.25	0	24.79
Potential evapotranspiration (32 °F.) [1]	0	0	0	0	1.27	4.52	5.70	4.94	2.22	0	0	0	18.65
Potential evapotranspiration (28 °F.) [2]	0	0	0	0	2.44	4.52	5.70	4.94	3.03	.05	0	0	20.68
Average precipitation minus potential evapotranspiration	+ .28	+ .39	+ .45	+ .36	— .48	—1.77	—4.29	—3.99	—2.02	— .85	+ .22	+ .43	—11.27
Yoder:													
Maximum potential evapotranspiration	0	0	.27	1.49	2.97	4.46	5.76	4.99	3.12	1.69	.21	0	24.96
Potential evapotranspiration (32 °F.) [1]	0	0	0	0	1.05	4.46	5.76	4.99	2.29	0	0	0	18.55
Potential evapotranspiration (28 °F.) [2]	0	0	0	0	2.01	4.46	5.76	4.99	3.12	.05	0	0	20.39
Average precipitation minus potential evapotranspiration	+ .28	+ .36	+ .46	+ .29	— .56	—1.97	—4.23	—3.96	—2.09	— .91	+ .21	+ .37	—11.75

[1] Calculated from the last 32° temperature in spring to the first in fall.
[2] Calculated from the last 28° temperature in spring to the first in fall.

TABLE 13.—*Probability, amount, and frequency of short-duration maximum precipitation*

Period of—	Duration										
	30 minutes	1 hour	2 hours	3 hours	6 hours	12 hours	24 hours	2 days	4 days	7 days	10 days
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
2 Years	.7	1.0	1.2	1.3	1.4	1.5	1.7	1.9	2.3	2.7	2.9
5 Years	1.0	1.3	1.5	1.6	1.7	2.1	2.4	2.6	3.0	3.3	3.8
10 Years	1.2	1.6	1.8	1.9	2.2	2.5	2.8	3.0	3.5	4.0	4.4
25 Years	1.5	1.9	2.2	2.3	2.6	2.9	3.3	3.7	4.2	4.8	5.3
50 Years	1.7	2.1	2.5	2.7	2.9	3.3	3.8	4.2	4.8	5.4	5.8

and about 60 percent between the last 28° temperature in spring and the first in fall. Moisture from the Pacific Ocean is largely blocked off by numerous mountain chains between the Area and the west coast.

Sunshine is abundant. It is estimated to average about 65 percent of that annually possible, ranging from about 55 percent in winter to about 75 percent in summer.

The average windspeed is 13 miles an hour. The strongest winds occur during the period November through May. The average windspeed in April is 15 miles an hour, and in August, 10 miles an hour.

Relative humidity is estimated to be about 60 percent, ranging from about 55 percent in July to about 65 percent in January. The daily relative humidity in July ranges from about 80 percent at 5 a.m. to about 40 percent at 5 p.m. In January, the range at those hours is 75 to 55 percent.

History and Development

The first settlement in Wyoming, Fort William, was established in 1834, on the Laramie River near its junction with the North Platte River. The Government acquired the fort in 1849, renamed it Fort Laramie, and used it as an army post until 1890. Cattle ranchers arrived in the area in the late 1860's and early 1870's. Homesteaders came to the area from the late 1870's until about 1920.

Goshen County was formed in 1911. Torrington is the county seat and the principal market and trading center. Other towns are Fort Laramie, Hawk Springs, Huntley, LaGrange, Lingle, Veteran, and Yoder.

Railroads provide daily freight service from Torrington, Lingle, Fort Laramie, Veteran, Yoder, Huntley, Hawk Springs, and LaGrange. They also provide direct connections with agricultural markets in the Midwest and the Rocky Mountain area. Farm-to-market transportation is also provided by two Federal highways, State roads, and other well-maintained roads.

The largest industrial facility is the sugar refinery. This plant provides employment for about 75 workers full time and as many as 450 during the fall season.

Farming and Ranching

The southern part of Goshen County has a land area of 819,723 acres, of which about 97 percent is used for farming and ranching. About 10 percent is used for irrigated cropland, about 20 percent for dry cropland, and about 67 percent for rangeland.

Cattle ranching began about 1868. Cattle production increased in the 1870's, reached its peak in the early 1880's, and then declined rapidly. The main reasons for this decline were the severe overgrazing of rangeland, the disastrous winter of 1886–87, which killed many cattle, the introduction of sheep into the Area, and the ever-increasing number of homesteaders. Cattle ranching, however, has continued to be the most important livestock enterprise in the Area.

Irrigation was begun by cattle ranchers, who diverted water from streams onto adjacent bottom land to produce hay and grain for winter feed. The first cooperative efforts among farmers were the construction of the North Platte Canal in 1883, the Torrington Canal in 1886, and the Lucerne Canal in 1892. The development of the present extensive irrigation system was made possible by the Reclamation Act of 1902. The Pathfinder Dam on the North Platte River, one of the first projects, was completed in 1910. Subsequent storage facilities were developed at Seminoe, Guernsey, and Glendo Reservoirs. These helped insure sufficient distribution of irrigation water in this Area. The Interstate Canal was completed in 1915, and the Fort Laramie Canal in 1925. The facilities for storage of irrigation water and the distribution systems that have been developed on Horse Creek and its tributaries have aided irrigation. Many wells have been developed as a source of supplemental water. The principal irrigated crops are sugar beets, corn, alfalfa, beans, and potatoes. The abundance of hay, grain, and by-products of the sugar-beet industry has helped to promote the development of extensive cattle and sheep-feeding operations.

Dryland farming began on a small scale about 1910 and increased until the severe drought in the early 1930's. A system of alternating strips of crops with summer fallow was adopted by the late 1930's. Since

that time, dryland farming has been an important practice in this Area.

The principal dryland crops are small grains, mainly winter wheat.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. An excavation produced by wind action in loose soil, usually sand.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Evapotranspiration. That part of the root zone moisture which is consumed by evaporation and transpiration combined, including all water consumed by plants plus the water evaporated from bare land and water surface.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Leaching. The removal of soluble materials from soils or other soil material by percolating water.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

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Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which soil forms.

Ridging. Making small embankments or borders in fields to control irrigation water, conserve runoff from rainfall, or to assist in drainage.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular, and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. The suitability of the soils for use as cropland is discussed in the soil descriptions. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 53.
Engineering uses of the soils, tables 4, 5, and 6, pages 64 through 83.

Map symbol	Mapping unit	Described on page	Capability Unit Dryland	Capability Unit Irrigated	Range site Name	Range site Page	Windbreak site Name	Windbreak site Page
Ak	Alkali and saline land	8	VIws-10	VIws-10	--	--	--	--
AlB	Anselmo fine sandy loam, 0 to 6 percent slopes	8	IVe-5	--	Sandy	58	Sandy	61
AmA	Anselmo and Dwyer soils, 0 to 3 percent slopes	9						
	Anselmo part	--	IIIe-5	IIe-5	Sandy	58	Sandy	61
	Dwyer part	--	IVe-4	IIIe-4	Sandy	58	Sandy	61
AmB	Anselmo and Dwyer soils, 3 to 6 percent slopes	9						
	Anselmo part	--	IVe-5	IIIe-5	Sandy	58	Sandy	61
	Dwyer part	--	VIe-4	IVe-4	Sandy	58	Very Sandy	61
AmC	Anselmo and Dwyer soils, 6 to 10 percent slopes	9						
	Anselmo part	--	IVe-5	IVe-5	Sandy	58	Sandy	61
	Dwyer part	--	VIe-4	IVe-4	Sandy	58	Very Sandy	61
AmD	Anselmo and Dwyer soils, 10 to 15 percent slopes	9						
	Anselmo part	--	VIe-5	VIe-5	Sandy	58	Sandy	61
	Dwyer part	--	VIe-4	VIe-4	Sandy	58	Very Sandy	61
AsA	Anselmo and Shingle soils, 0 to 3 percent slopes	10						
	Anselmo part	--	IIIe-5	IIIe-5	Sandy	58	Sandy	61
	Shingle part	--	VIs-14	IVs-14	Shallow Loamy	59	Unsuitable	61
AsC	Anselmo and Shingle soils, 3 to 10 percent slopes	10						
	Anselmo part	--	IVe-5	IVe-5	Sandy	58	Sandy	61
	Shingle part	--	VIe-14	VIe-14	Shallow Loamy	59	Unsuitable	61
AsD	Anselmo and Shingle soils, 10 to 15 percent slopes	10						
	Anselmo part	--	VIe-5	VIe-5	Sandy	58	Sandy	61
	Shingle part	--	VIIe-14	VIe-14	Shallow Loamy	59	Unsuitable	61
AtA	Anselmo-Trelona loamy fine sands, 0 to 3 percent slopes	10						
	Anselmo part	--	IVe-4	--	Sandy	58	Sandy	61
	Trelona part	--	VIs-14	--	Shallow Sandy	58	Unsuitable	61
AuB	Ascalon fine sandy loam, 0 to 6 percent slopes	11	IIIe-5	--	Sandy	58	Sandy	61
AuC	Ascalon fine sandy loam, 6 to 10 percent slopes	11	IVe-5	--	Sandy	58	Sandy	61
Bd	Badlands	12	VIIIs-83	--	--	--	--	--
BfA	Bankard loamy fine sand, 0 to 3 percent slopes	12	IVe-4	IIIe-4	Sandy Lowland	57	Sandy	61
BfB	Bankard loamy fine sand, 3 to 6 percent slopes	12	VIe-4	IVe-4	Sandy Lowland	57	Very Sandy	61
BgB	Bayard fine sandy loam, 0 to 7 percent slopes	13	IIIe-5	IIe-5	Sandy	58	Sandy	61

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability Unit Dryland	Capability Unit Irrigated	Range site		Windbreak site	
			Symbol	Symbol	Name	Page	Name	Page
BoA	Bayard and Otero fine sandy loams, 0 to 3 percent slopes	13	IIIe-5	IIe-5	Sandy	58	Sandy	61
BoB	Bayard and Otero fine sandy loams, 3 to 6 percent slopes	13	IVe-5	IIIe-5	Sandy	58	Sandy	61
BrA	Bordeaux fine sandy loam, 0 to 3 percent slopes	14	IIIe-5	IIe-5	Sandy	58	Sandy	61
BrB	Bordeaux fine sandy loam, 3 to 6 percent slopes	14	IVe-5	IIIe-5	Sandy	58	Sandy	61
BrC	Bordeaux fine sandy loam, 6 to 10 percent slopes	14	IVe-5	IVe-5	Sandy	58	Sandy	61
ChB	Chappell and Hawksprings fine sandy loams, 0 to 6 percent slopes	15	IVe-5	IIIe-5	Sandy	58	Sandy	61
ChC	Chappell and Hawksprings fine sandy loams, 6 to 10 percent slopes	15	VIe-5	IVe-5	Sandy	58	Sandy	61
ClD	Chappell complex, 10 to 15 percent slopes	16						
	Chappell part	--	VIe-5	VIe-5	Sandy	58	Sandy	61
	Dix part	--	VIIe-6	--	Gravelly	59	Unsuitable	61
CoC	Colby loam, 3 to 10 percent slopes	16	IVe-3	--	Limy Upland	58	Silty to Clayey	60
CoD	Colby loam, 10 to 20 percent slopes	16	VIe-3	--	Limy Upland	58	Silty to Clayey	60
CtC	Colby-Tassel complex, 2 to 8 percent slopes	16						
	Colby part	--	IVe-3	--	Limy Upland	58	Silty to Clayey	60
	Tassel part	--	VIe-14	--	Shallow Sandy	58	Unsuitable	61
CvB	Creighton very fine sandy loam, 0 to 6 percent slopes	17	IIIe-5	--	Loamy	58	Sandy	61
CvC	Creighton very fine sandy loam, 6 to 10 percent slopes	17	IVe-5	--	Loamy	58	Sandy	61
CvD	Creighton very fine sandy loam, 10 to 20 percent slopes	17	VIe-5	--	Loamy	58	Sandy	61
DcD	Dix complex, 0 to 10 percent slopes	18	VIe-6	--	Gravelly	59	Unsuitable	61
DcE	Dix complex, 10 to 40 percent slopes	18						
	Dix part	--	VIIe-6	--	Gravelly	59	Unsuitable	61
	Valentine and Dwyer parts	--	VIIe-15	--	Choppy Sands	58	Unsuitable	61
DdA	Dunday and Dwyer loamy fine sands, 0 to 3 percent slopes	19	IVe-4	IIIe-4	Sandy	58	Sandy	61
DdC	Dunday and Dwyer loamy fine sands, 3 to 10 percent slopes	19	VIe-4	IVe-4	Sandy	58	Very Sandy	61
DeE	Dunday-Trelona complex, 3 to 35 percent slopes	20						
	Dunday part	--	VIe-4	--	Sandy	58	Very Sandy	61
	Trelona part	--	VIIe-14	--	Shallow Sandy	58	Unsuitable	61
DfA	Dunday and Vetal loamy fine sands, 0 to 3 percent slopes	20	IVe-4	--	Sandy	58	Sandy	61
DfC	Dunday and Vetal loamy fine sands, 3 to 10 percent slopes	20	VIe-4	--	Sandy	58	Very Sandy	61
Dn	Dune land	21	VIIIe-15	--	--	--	--	--
DuA	Duroc loam, 0 to 1 percent slopes	21	IIc-46	I-1	Loamy Overflow	57	Silty to Clayey	60
DuB	Duroc loam, 1 to 3 percent slopes	21	IIIe-2	IIe-2	Loamy	58	Silty to Clayey	60
DwA	Dwyer loamy fine sand, 0 to 3 percent slopes	22	IVe-4	IIIe-4	Sandy	58	Sandy	61

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability Unit Dryland	Capability Unit Irrigated	Range site		Windbreak site	
			Symbol	Symbol	Name	Page	Name	Page
DwC	Dwyer loamy fine sand, 3 to 10 percent slopes	22	VIe-4	IVe-4	Sandy	58	Very Sandy	61
DyD	Dwyer and Mitchell soils, 10 to 15 percent slopes	22						
	Dwyer part	--	VIe-4	--	Sandy	58	Very Sandy	61
	Mitchell part	--	VIe-3	--	Loamy	58	Silty to Clayey	60
EpB	Epping silt loam, 0 to 6 percent slopes	23	VIe-14	IVe-14	Shallow Loamy	59	Unsuitable	61
EpC	Epping silt loam, 6 to 10 percent slopes	23	VIe-14	VIe-14	Shallow Loamy	59	Unsuitable	61
EpD	Epping silt loam, 10 to 15 percent slopes	23	VIIe-14	VIe-14	Shallow Loamy	59	Unsuitable	61
GbA	Glenberg fine sandy loam, 0 to 3 percent slopes	23	IVe-5	IIe-5	Sandy Lowland	57	Sandy	61
GkA	Goshen-Kuma loams, 0 to 2 percent slopes	24	IIc-46	I-1	Loamy Overflow	57	Silty to Clayey	60
Gu	Gullied land	24	VIIe-82	--	--	--	--	--
HaA	Haverson fine sandy loam, 0 to 3 percent slopes	25	IIIe-5	IIe-5	Sandy Lowland	57	Sandy	61
HgA	Haverson loam, gravel substratum variant, 0 to 3 percent slopes	26	IIIs-2	IIs-2	Loamy Lowland	57	Silty to Clayey	60
HnA	Haverson and McCook loams, 0 to 3 percent slopes	26	IIIc-2	I-1	Loamy Lowland	57	Silty to Clayey	60
HtA	Haldt clay, 0 to 3 percent slopes	27	IVs-1	IIIs-1	Clayey	58	Silty to Clayey	60
KeA	Keith loam, 0 to 1 percent slopes	28	IIIc-2	I-1	Loamy	58	Silty to Clayey	60
KeB	Keith loam, 1 to 3 percent slopes	28	IIIe-2	IIe-2	Loamy	58	Silty to Clayey	60
KeC	Keith loam, 3 to 6 percent slopes	28	IIIe-2	IIIe-2	Loamy	58	Silty to Clayey	60
KoA	Keota silt loam, 0 to 3 percent slopes	29	IVe-3	IIe-3	Loamy	58	Silty to Clayey	60
KoB	Keota silt loam, 3 to 6 percent slopes	29	IVe-3	IIIe-3	Loamy	58	Silty to Clayey	60
KpD	Keota-Epping silt loams, 6 to 15 percent slopes	29						
	Keota part	--	VIe-3	VIe-3	Loamy	58	Silty to Clayey	60
	Epping part	--	VIe-14	VIe-14	Shallow Loamy	59	Unsuitable	61
KyA	Kim clay loam, alkali, 0 to 1 percent slopes	30	IVs-1	IIIs-1	Clayey	58	Silty to Clayey	60
KyB	Kim clay loam, alkali, 1 to 3 percent slopes	30	IVe-1	IIIe-1	Clayey	58	Silty to Clayey	60
KyC	Kim clay loam, alkali, 3 to 10 percent slopes	30	IVe-1	IVe-1	Clayey	58	Silty to Clayey	60

Map symbol	Mapping unit	Described on page	Capability Unit Dryland	Capability Unit Irrigated	Range site		Windbreak site	
			Symbol	Symbol	Name	Page	Name	Page
MaB	Marsh and Wet land, 0 to 5 percent slopes	32	IVw-63	IIIw-63	--	--	Moderately Wet	61
MeA	Manter and Anselmo fine sandy loams, 0 to 3 percent slopes	31	IIIe-5	IIe-5	Sandy	58	Sandy	61
MeB	Manter and Anselmo fine sandy loams, 3 to 6 percent slopes	32	IVe-5	IIIe-5	Sandy	58	Sandy	61
MeC	Manter and Anselmo fine sandy loams, 6 to 10 percent slopes	32	IVe-5	IVe-5	Sandy	58	Sandy	61
MsA	Mitchell-Shingle loams, 0 to 3 percent slopes	33						
	Mitchell part	--	IVe-3	IIIe-3	Loamy	58	Silty to Clayey	60
	Shingle part	--	VIs-14	IVs-14	Shallow Loamy	59	Unsuitable	61
MsC	Mitchell-Shingle loams, 3 to 10 percent slopes	34						
	Mitchell part	--	IVe-3	IVe-3	Loamy	58	Silty to Clayey	60
	Shingle part	--	VIe-14	VIe-14	Shallow Loamy	59	Unsuitable	61
MtA	Mitchell silt loam, 0 to 3 percent slopes	34	IVe-3	IIe-3	Loamy	58	Silty to Clayey	60
MtB	Mitchell silt loam, 3 to 6 percent slopes	34	IVe-3	IIIe-3	Loamy	58	Silty to Clayey	60
MtC	Mitchell silt loam, 6 to 10 percent slopes	34	IVe-3	IVe-3	Loamy	58	Silty to Clayey	60
MtD	Mitchell silt loam, 10 to 15 percent slopes	35	VIe-3	VIe-3	Loamy	58	Silty to Clayey	60
Mu	Mixed alluvial land	35	VIIs-6	--	--	--	--	--
NoA	Norka loam, 0 to 1 percent slopes	36	IIIc-2	--	Loamy	58	Silty to Clayey	60
NoB	Norka loam, 1 to 6 percent slopes	36	IIIe-2	--	Loamy	58	Silty to Clayey	60
NrB	Norka and Colby loams, 0 to 6 percent slopes	36						
	Norka part	--	IIIe-2	--	Loamy	58	Silty to Clayey	60
	Colby part	--	IVe-3	--	Limy Upland	58	Silty to Clayey	60
NwB	Norka-Weld loams, 0 to 6 percent slopes	36	IIIe-2	--	Loamy	58	Silty to Clayey	60
NwC	Norka-Weld loams, 6 to 10 percent slopes	37	IVe-2	--	Loamy	58	Silty to Clayey	60
OcA	Orella clay, 0 to 3 percent slopes	37	VIs-1	VIs-14	Saline Upland	59	Unsuitable	61
OeD	Orella and Epping soils, 3 to 15 percent slopes	37						
	Orella part	--	VIe-14	--	Saline Upland	59	Unsuitable	61
	Epping part	--	VIIe-14	--	Shallow Loamy	59	Unsuitable	61
OtA	Otero fine sandy loam, 0 to 3 percent slopes	38	IIIe-5	IIe-5	Sandy	58	Sandy	61

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability Unit Dryland	Capability Unit Irrigated	Range site Name	Range site Page	Windbreak site Name	Windbreak site Page
OtB	Otero fine sandy loam, 3 to 6 percent slopes	38	IVe-5	IIIe-5	Sandy	58	Sandy	61
OtC	Otero fine sandy loam, 6 to 10 percent slopes	38	VIe-5	IVe-5	Sandy	58	Sandy	61
Rc	Rock land	38						
	Rock Outcrop part	--	VIIIs-83	--	--	--	--	--
	Tassel and Trelona parts	--	VIIe-14	--	Shallow Sandy	58	Unsuitable	61
	Dunday and Dwyer parts	--	VIe-4	--	Sandy	58	Very Sandy	61
Rd	Rock Outcrop-Tassel complex	39						
	Tassel part	--	VIIe-14	--	--	--	Unsuitable	61
	Rock Outcrop part	--	VIIIs-83	--	Shallow Sandy	58	Unsuitable	61
ReA	Rosebud-Dunday-Trelona loamy fine sands, 0 to 3 percent slopes	39						
	Rosebud part	--	IVe-4	--	Sandy	58	Sandy	61
	Dunday part	--	IVe-4	--	Sandy	58	Sandy	61
	Trelona part	--	VIs-14	--	Shallow Sandy	58	Unsuitable	61
ReC	Rosebud-Dunday-Trelona loamy fine sands., 3 to 10 percent slopes	40						
	Rosebud part	--	VIe-4	--	Sandy	58	Very Sandy	61
	Dunday part	--	VIe-4	--	Sandy	58	Very Sandy	61
	Trelona part	--	VIe-14	--	Shallow Sandy	58	Unsuitable	61
RhB	Rosebud and Hargreave fine sandy loams, 0 to 6 percent slopes	40	IIIe-5	--	Loamy	58	Sandy	61
RhC	Rosebud and Hargreave fine sandy loams, 6 to 10 percent slopes	40	IVe-5	--	Loamy	58	Sandy	61
RnA	Rosebud and Norka loams, 0 to 1 percent slopes	40	IIIc-2	--	Loamy	58	Silty to Clayey	60
RnB	Rosebud and Norka loams, 1 to 6 percent slopes	40	IIIe-2	--	Loamy	58	Silty to Clayey	60
RnC	Rosebud and Norka loams, 6 to 10 percent slopes	40	IVe-2	--	Loamy	58	Silty to Clayey	60
RsA	Rosebud and Satanta loams, 0 to 3 percent slopes	41	IIIe-2	--	Loamy	58	Silty to Clayey	60
RtB	Rosebud-Trelona complex, 0 to 6 percent slopes	41						
	Rosebud part	--	IIIe-2	--	Loamy	58	Silty to Clayey	60
	Trelona part	--	VIe-14	--	Shallow Sandy	58	Unsuitable	61
RuB	Rosebud-Trelona fine sandy loams, 0 to 6 percent slopes	41						
	Rosebud part	--	IIIe-5	--	Loamy	58	Sandy	61
	Trelona part	--	VIe-14	--	Shallow Sandy	58	Unsuitable	61
RuC	Rosebud-Trelona fine sandy loams, 6 to 10 percent slopes	41						
	Rosebud part	--	IVe-5	--	Loamy	58	Sandy	61
	Trelona part	--	VIe-14	--	Shallow Sandy	58	Unsuitable	61

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability Unit Dryland	Capability Unit Irrigated	Range site		Windbreak site	
			Symbol	Symbol	Name	Page	Name	Page
RuD	Rosebud-Trelona fine sandy loams, 10 to 20 percent slopes	42						
	Rosebud part	--	VIe-5	--	Loamy	58	Sandy	61
	Trelona part	--	VIIe-14	--	Shallow Sandy	58	Unsuitable	61
SaA	Satanta fine sandy loam, 0 to 3 percent slopes	42	IIIe-5	IIe-5	Loamy	58	Sandy	61
StA	Satanta loam, 0 to 1 percent slopes	43	IIIc-2	I-1	Loamy	58	Silty to Clayey	60
StB	Satanta loam, 1 to 3 percent slopes	43	IIIe-2	IIe-2	Loamy	58	Silty to Clayey	60
StC	Satanta loam, 3 to 6 percent slopes	43	IIIe-2	IIIe-2	Loamy	58	Silty to Clayey	60
StD	Satanta loam, 6 to 10 percent slopes	43	IVe-2	IVe-2	Loamy	58	Silty to Clayey	60
UlA	Ulysses loam, 0 to 1 percent slopes	45	IIIc-2	I-1	Loamy	58	Silty to Clayey	60
UlB	Ulysses loam, 1 to 3 percent slopes	45	IIIe-2	IIe-2	Loamy	58	Silty to Clayey	60
UlC	Ulysses loam, 3 to 6 percent slopes	46	IIIe-2	IIIe-2	Loamy	58	Silty to Clayey	60
Vh	Valentine and Dwyer fine sands, hilly	46	VIIe-15	--	Choppy Sands	58	Unsuitable	61
Vr	Valentine and Dwyer fine sands, rolling	46	VIe-15	VIs-15	Sands	57	Very Sandy	61
VtB	Vetal fine sandy loam, 0 to 4 percent slopes	47	IIIe-5	IIe-5	Sandy	58	Sandy	61

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program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WYOMING AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

GOSHEN COUNTY, WYOMING, SOUTHERN PART

Scale 1:253,440

1 0 1 2 3 4 Miles

N

SOIL ASSOCIATIONS

1 Satanta-Mitchell association: Deep, nearly level to sloping, well-drained, loamy soils on uplands

2 Rosebud-Norka-Creighton association: Moderately deep to deep, nearly level to sloping, well-drained, loamy soils on uplands

3 Anselmo-Manter-Dwyer association: Deep, nearly level to sloping, well drained to excessively drained, sandy and loamy soils on uplands

4 Dunday-Trelona-Dwyer association: Deep to shallow, nearly level to steep, excessively drained to well drained, sandy and loamy soils on uplands

5 Valentine-Dwyer association: Deep, nearly level to steep, excessively drained sands on uplands

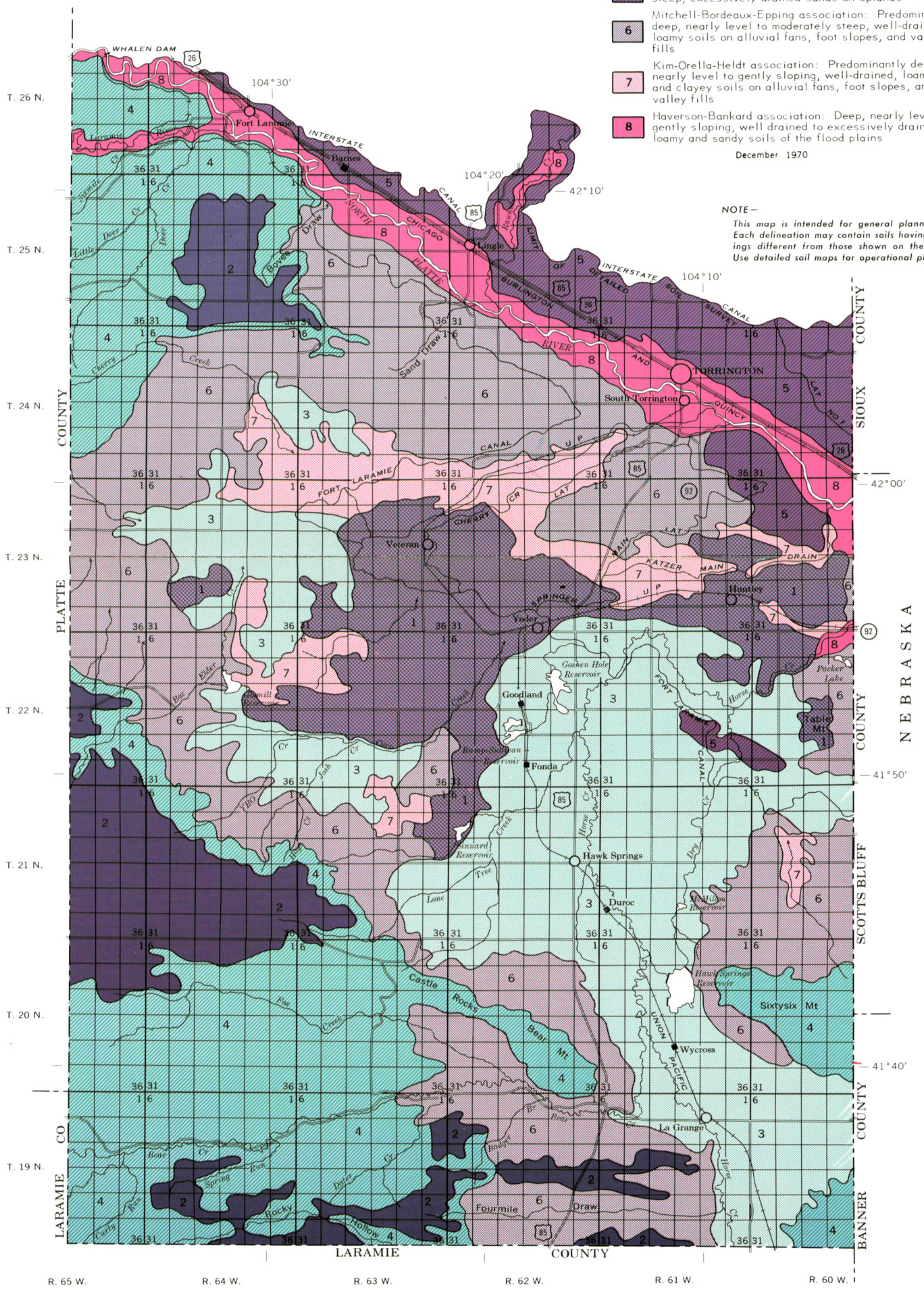
6 Mitchell-Bordeaux-Epping association: Predominantly deep, nearly level to moderately steep, well-drained, loamy soils on alluvial fans, foot slopes, and valley fills

7 Kim-Orella-Heldt association: Predominantly deep, nearly level to gently sloping, well-drained, loamy and clayey soils on alluvial fans, foot slopes, and valley fills

8 Haverson-Bankard association: Deep, nearly level to gently sloping, well drained to excessively drained, loamy and sandy soils of the flood plains

December 1970

NOTE—
This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning.



INDEX TO MAP SHEETS

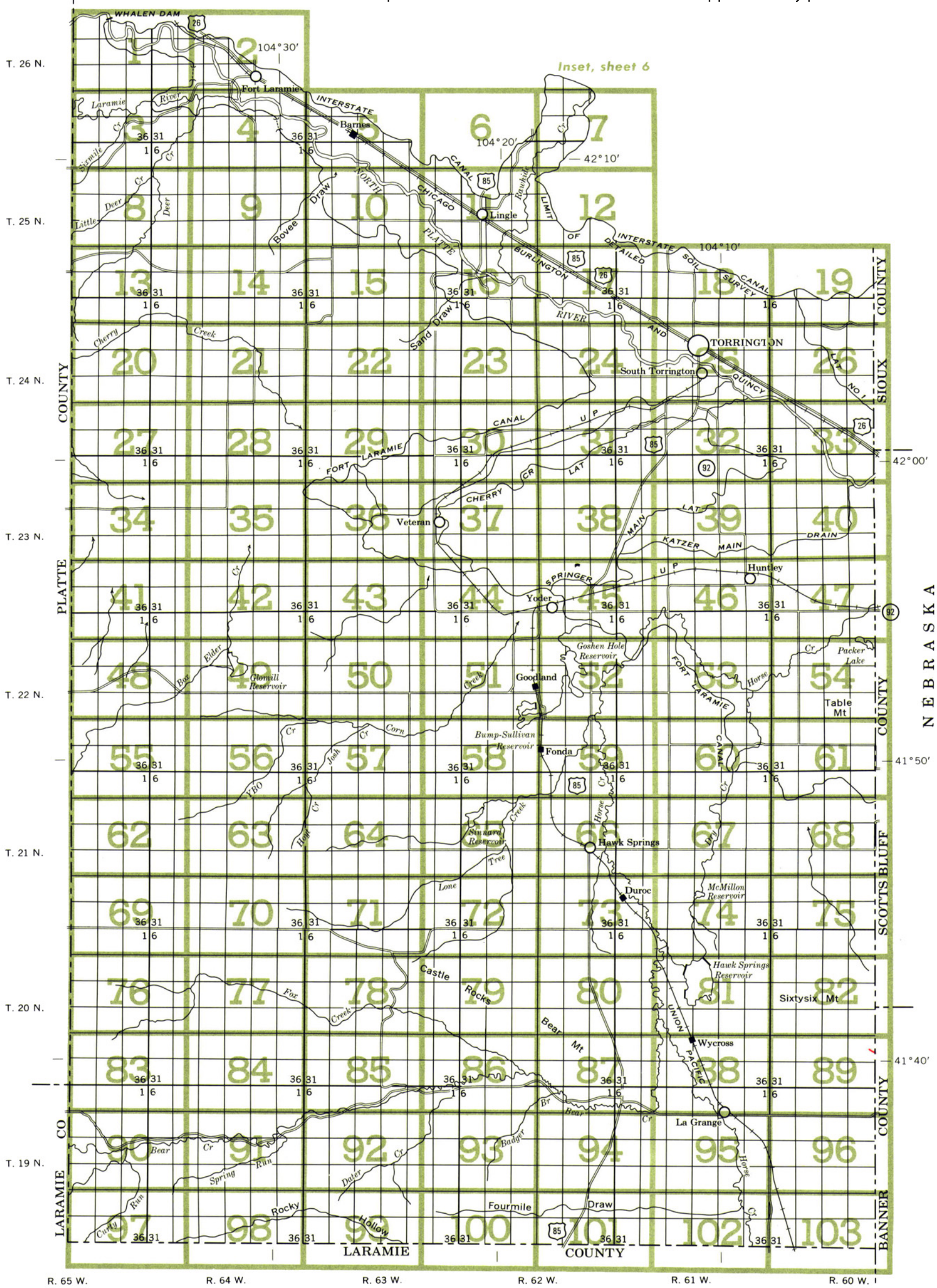
GOSHEN COUNTY, WYOMING, SOUTHERN PART

N

Scale 1:253,440

1 0 1 2 3 4 Miles

Original text from each individual map sheet read:
This map is one of a set compiled in 1970 as a part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station. Land division corners are approximately positioned on this map.



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most of the symbols without a slope letter are those of land types or soils that have a considerable range in slope.

SYMBOL	NAME
Ak	Alkali and saline land
AlB	Anselmo fine sandy loam, 0 to 6 percent slopes
AmA	Anselmo and Dwyer soils, 0 to 3 percent slopes
AmB	Anselmo and Dwyer soils, 3 to 6 percent slopes
AmC	Anselmo and Dwyer soils, 6 to 10 percent slopes
AmD	Anselmo and Dwyer soils, 10 to 15 percent slopes
AsA	Anselmo and Shingle soils, 0 to 3 percent slopes
AsC	Anselmo and Shingle soils, 3 to 10 percent slopes
AsD	Anselmo and Shingle soils, 10 to 15 percent slopes
AtA	Anselmo-Trelona loamy fine sands, 0 to 3 percent slopes
AuB	Ascalon fine sandy loam, 0 to 6 percent slopes
AuC	Ascalon fine sandy loam, 6 to 10 percent slopes
Bd	Badlands
BfA	Bankard loamy fine sand, 0 to 3 percent slopes
BfB	Bankard loamy fine sand, 3 to 6 percent slopes
BgB	Bayard fine sandy loam, 0 to 7 percent slopes
BoA	Bayard and Otero fine sandy loams, 0 to 3 percent slopes
BoB	Bayard and Otero fine sandy loams, 3 to 6 percent slopes
BrA	Bordeaux fine sandy loam, 0 to 3 percent slopes
BrB	Bordeaux fine sandy loam, 3 to 6 percent slopes
BrC	Bordeaux fine sandy loam, 6 to 10 percent slopes
ChB	Chappell and Hawksprings fine sandy loams, 0 to 6 percent slopes
ChC	Chappell and Hawksprings fine sandy loams, 6 to 10 percent slopes
ClD	Chappell complex, 10 to 15 percent slopes
CoC	Colby loam, 3 to 10 percent slopes
CoD	Colby loam, 10 to 20 percent slopes
CtC	Colby-Tassel complex, 2 to 8 percent slopes
CvB	Creighton very fine sandy loam, 0 to 6 percent slopes
CvC	Creighton very fine sandy loam, 6 to 10 percent slopes
CvD	Creighton very fine sandy loam, 10 to 20 percent slopes
DcD	Dix complex, 0 to 10 percent slopes
DcE	Dix complex, 10 to 40 percent slopes
DdA	Dunday and Dwyer loamy fine sands, 0 to 3 percent slopes
DdC	Dunday and Dwyer loamy fine sands, 3 to 10 percent slopes
DeE	Dunday-Trelona complex, 3 to 35 percent slopes
DfA	Dunday and Vetal loamy fine sands, 0 to 3 percent slopes
DfC	Dunday and Vetal loamy fine sands, 3 to 10 percent slopes
Dn	Dune land
DuA	Duroc loam, 0 to 1 percent slopes
DuB	Duroc loam, 1 to 3 percent slopes
DwA	Dwyer loamy fine sand, 0 to 3 percent slopes
DwC	Dwyer loamy fine sand, 3 to 10 percent slopes
DyD	Dwyer and Mitchell soils, 10 to 15 percent slopes
EpB	Epping silt loam, 0 to 6 percent slopes
EpC	Epping silt loam, 6 to 10 percent slopes
EpD	Epping silt loam, 10 to 15 percent slopes
GbA	Glenberg fine sandy loam, 0 to 3 percent slopes
GkA	Goshen-Kuma loams, 0 to 2 percent slopes
Gu	Gullied land
HaA	Haverson fine sandy loam, 0 to 3 percent slopes
HgA	Haverson loam, gravel substratum variant, 0 to 3 percent slopes
HnA	Haverson and McCook loams, 0 to 3 percent slopes
HtA	Heldt clay, 0 to 3 percent slopes
KeA	Keith loam, 0 to 1 percent slopes
KeB	Keith loam, 1 to 3 percent slopes
KeC	Keith loam, 3 to 6 percent slopes
KoA	Keota silt loam, 0 to 3 percent slopes
KoB	Keota silt loam, 3 to 6 percent slopes
KpD	Keota-Epping silt loams, 6 to 15 percent slopes
KyA	Kim clay loam, alkali, 0 to 1 percent slopes
KyB	Kim clay loam, alkali, 1 to 3 percent slopes
KyC	Kim clay loam, alkali, 3 to 10 percent slopes
MaB	Marsh and Wet land, 0 to 5 percent slopes
MeA	Manter and Anselmo fine sandy loams, 0 to 3 percent slopes
MeB	Manter and Anselmo fine sandy loams, 3 to 6 percent slopes
MeC	Manter and Anselmo fine sandy loams, 6 to 10 percent slopes
MsA	Mitchell-Shingle loams, 0 to 3 percent slopes
MsC	Mitchell-Shingle loams, 3 to 10 percent slopes
MtA	Mitchell silt loam, 0 to 3 percent slopes
MtB	Mitchell silt loam, 3 to 6 percent slopes
MtC	Mitchell silt loam, 6 to 10 percent slopes
MtD	Mitchell silt loam, 10 to 15 percent slopes
Mu	Mixed alluvial land
NoA	Norka loam, 0 to 1 percent slopes
NoB	Norka loam, 1 to 6 percent slopes
NrB	Norka and Colby loams, 0 to 6 percent slopes
NwB	Norka-Weld loams, 0 to 6 percent slopes
NwC	Norka-Weld loams, 6 to 10 percent slopes
OcA	Orella clay, 0 to 3 percent slopes
OeD	Orella and Epping soils, 3 to 15 percent slopes
OtA	Otero fine sandy loam, 0 to 3 percent slopes
OtB	Otero fine sandy loam, 3 to 6 percent slopes
OtC	Otero fine sandy loam, 6 to 10 percent slopes
Rc	Rock land
Rd	Rock outcrop-Tassel complex
ReA	Rosebud-Dunday-Trelona loamy fine sands, 0 to 3 percent slopes
ReC	Rosebud-Dunday-Trelona loamy fine sands, 3 to 10 percent slopes
RhB	Rosebud and Hargreave fine sandy loams, 0 to 6 percent slopes
RhC	Rosebud and Hargreave fine sandy loams, 6 to 10 percent slopes
RnA	Rosebud and Norka loams, 0 to 1 percent slopes
RnB	Rosebud and Norka loams, 1 to 6 percent slopes
RnC	Rosebud and Norka loams, 6 to 10 percent slopes
RsA	Rosebud and Satanta loams, 0 to 3 percent slopes
RtB	Rosebud-Trelona complex, 0 to 6 percent slopes
RuB	Rosebud-Trelona fine sandy loams, 0 to 6 percent slopes
RuC	Rosebud-Trelona fine sandy loams, 6 to 10 percent slopes
RuD	Rosebud-Trelona fine sandy loams, 10 to 20 percent slopes
SaA	Satanta fine sandy loam, 0 to 3 percent slopes
StA	Satanta loam, 0 to 1 percent slopes
StB	Satanta loam, 1 to 3 percent slopes
StC	Satanta loam, 3 to 6 percent slopes
StD	Satanta loam, 6 to 10 percent slopes
UlA	Ulysses loam, 0 to 1 percent slopes
UlB	Ulysses loam, 1 to 3 percent slopes
UlC	Ulysses loam, 3 to 6 percent slopes
Vh	Valentine and Dwyer fine sands, hilly
Vr	Valentine and Dwyer fine sands, rolling
VtB	Vetal fine sandy loam, 0 to 4 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

Wells, water (flowing)

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 1

1

N

640 000 FEET

660 000 FEET

R. 65 W. | R. 64 W.

575 000 FEET

565 000 FEET

T. 26 N.

PLATTE COUNTY

WHALEN DAM

FORT LARAMIE CANAL

NORTH PLATTE RIVER

INTERSTATE 80

SOIL SURVEY LIMITS

DETAILED SURVEY

(Joins sheet 2)

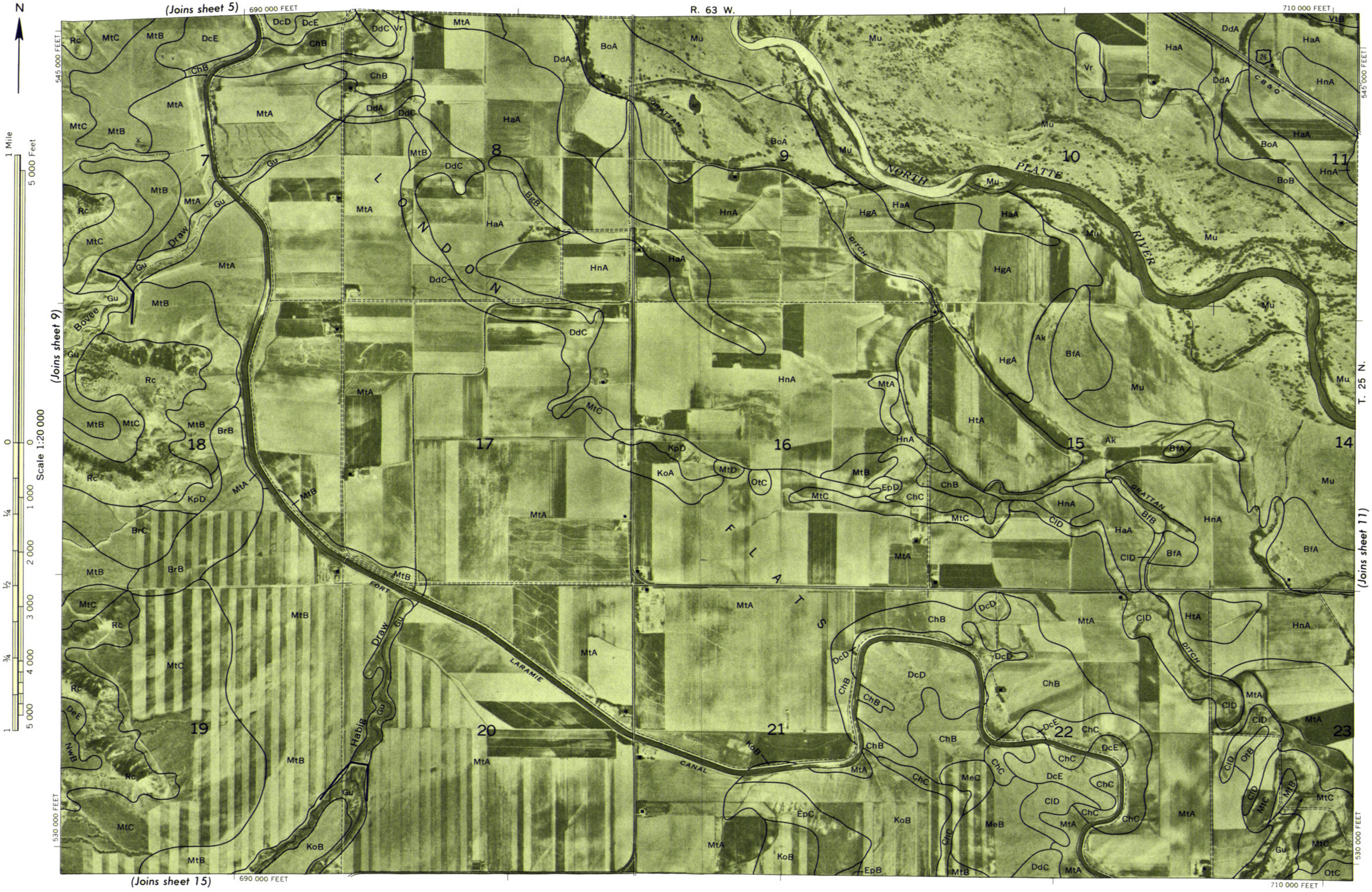
(Joins sheet 3)

1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.

N

R. 63 W. | R. 62 W.

(Joins sheet 93) | 715 000 FEET

735 000 FEET

335 000 FEET

325 000 FEET

(Joins sheet 99)

(Joins sheet 101)

T. 19 N.

Fourmile Draw

LARAMIE COUNTY

TUNNEL

26 25 30 29 28 35 36 31 32 33

AuB AuC BrB BrC Bd ChB ChC CID CoC DcD DcE DeE EpB EpC EpD Ak KoB KpD MtB MtC NwB NwC Rc VrB Vr

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

Scale 1:20 000

1 Mile 5 000 Feet

0 1 000 2 000 3 000 4 000 5 000

740 000 FEET

R. 62 W. | R. 61 W.

755 000 FEET

(Joins sheet 94)

T. 19 N.

335 000 FEET

(Joins sheet 100)

(Joins sheet 102)

Fourmile Draw

LARAMIE COUNTY

325 000 FEET

740 000 FEET

755 000 FEET

N

1 Mile

5 000 Feet

Scale 1:20 000

0 1 000 2 000 3 000 4 000 5 000

0 ¼ ½ ¾ 1

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.

102

N

760 000 FEET

780 000 FEET

(Joins sheet 95)

R. 61 W.

(Joins sheet 101)

(Joins sheet 103)

T. 19 N.

335 000 FEET

325 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

Fourmile Draw

Horse Creek

29 28 27 26 25 32 33 34 35 36

LARAMIE COUNTY

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 103

103

N

785 000 FEET

805 000 FEET

(Joins sheet 96)

R. 60 W.

335 000 FEET

325 000 FEET

T. 19 N.

(Joins sheet 102)

Johnson Ranch

McClure Ranch

Ninemile Rock

Ninemile Canyon

Wyoming Canyon

UNION PACIFIC

NEBRASKA

LARAMIE COUNTY

BANNER COUNTY

26 27 28 29 30 31 32 33 34 35

DfA DfC DdC DcE MtB MtA MeA MeB MeC ChB AsC AsD BrA BrB DwC EpB DeE DdA Vr Rc

1 Mile 5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

735 000 FEET

(Joins sheet 7)

R. 62 W. | R. 61 W.

755 000 FEET

545 000 FEET

T. 25 N.

535 000 FEET

530 000 FEET

(Joins sheet 11)

(Joins sheet 17)

1 Mile — 5 000 Feet

Scale 1:20 000

0 — 0

¼ — 1 000

½ — 2 000

¾ — 4 000

1 — 5 000

DETAILED SOIL SURVEY OF INTERSTATE CANAL

LIMIT

Hanna Lakes

int

10 15 22 23 13 24 19

Vh BoA ChC DdC Vr ChB DcE MeA Ak DdA BoA DcD

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 13

13

N

640 000 FEET

660 000 FEET

R. 65 W. | R. 64 W.

(Joins sheet 8)

(Joins sheet 14)

(Joins sheet 20)

525 000 FEET

515 000 FEET

PLATTE COUNTY

T. 24 N. | T. 25 N.

Deer Creek

Cherry Creek

1 Mile

5 000 Feet

Scale 1:20 000

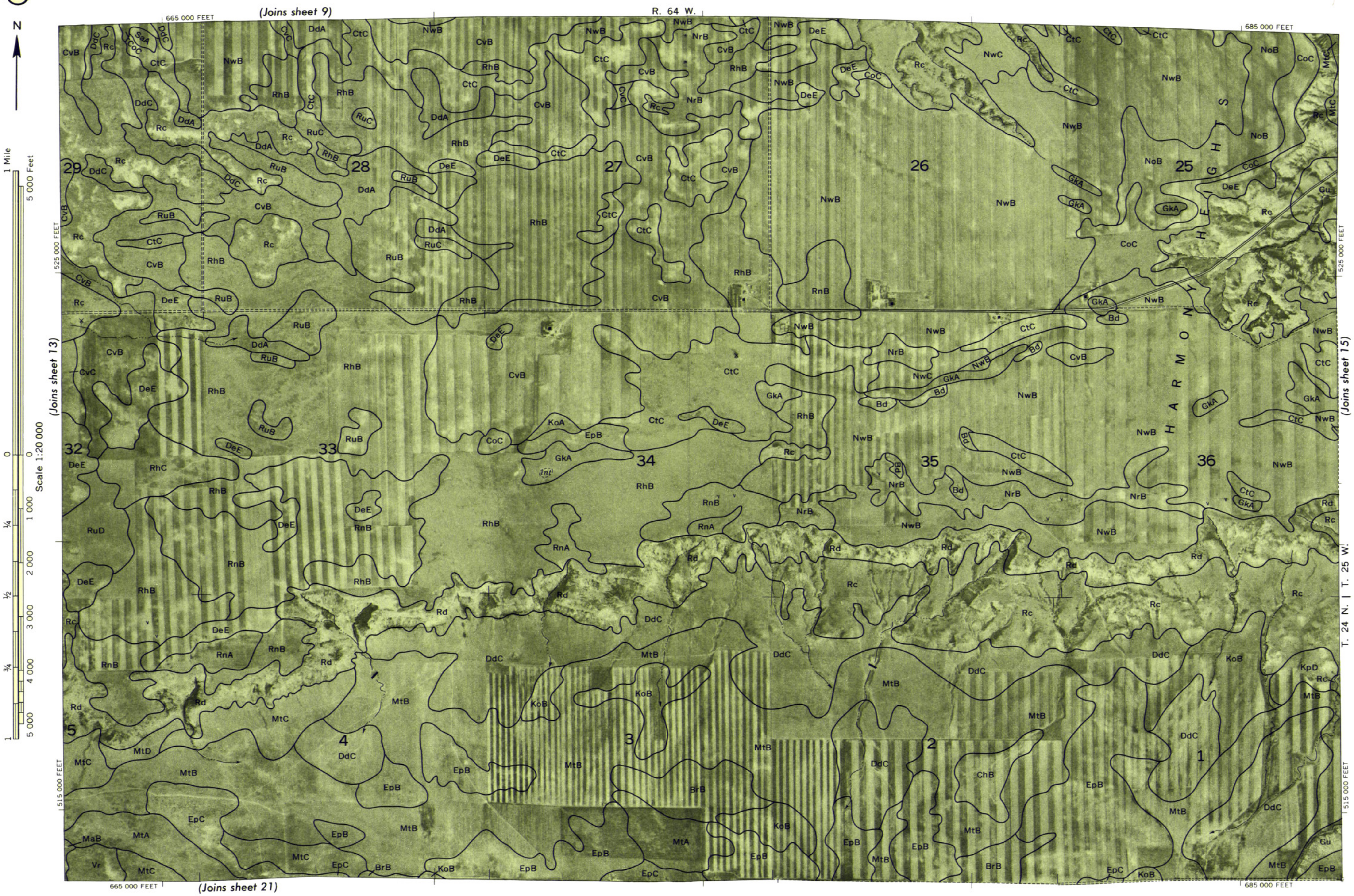
0

1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 14



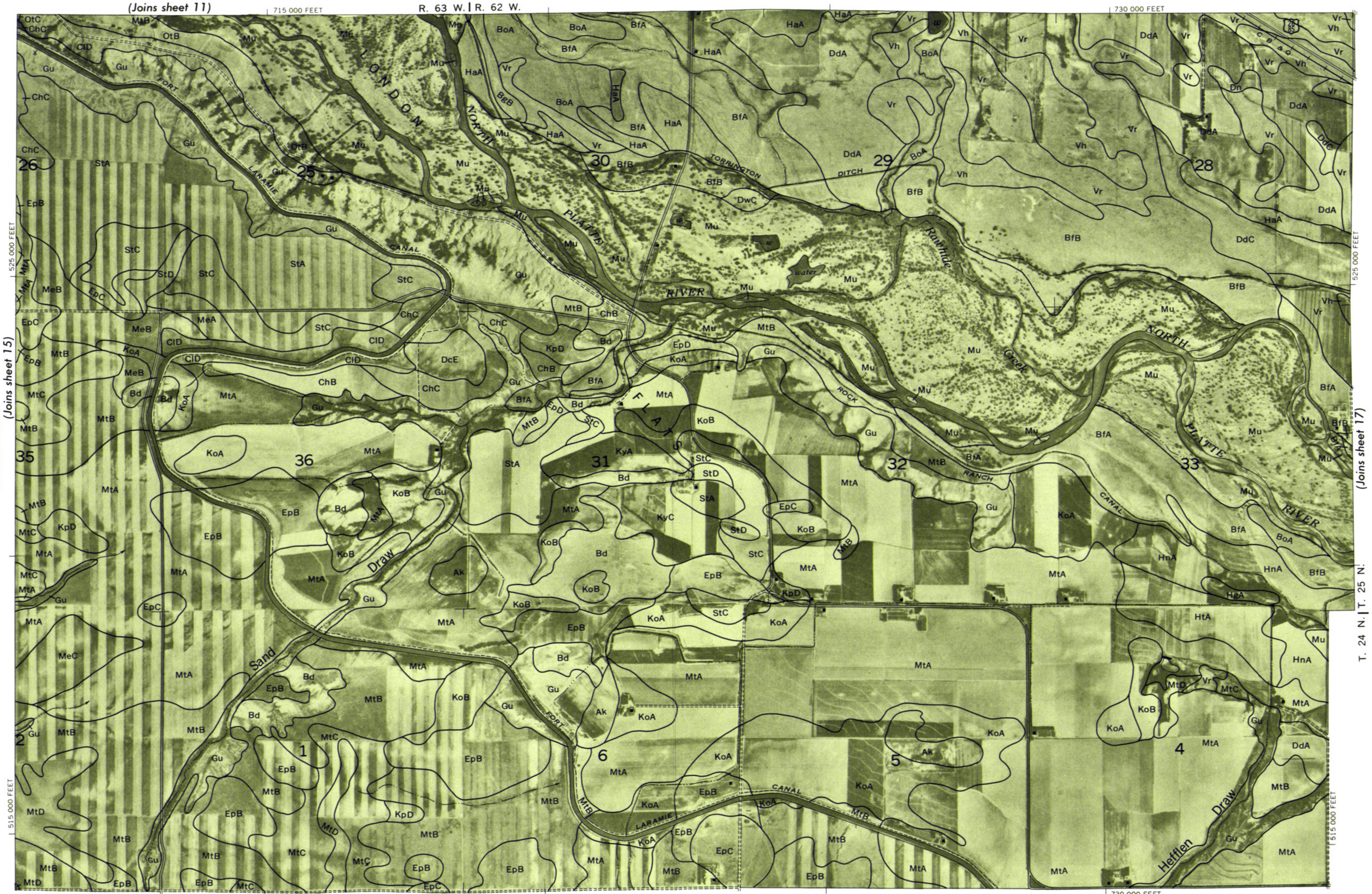
Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

(Joins sheet 11)

715 000 FEET R. 63 W. | R. 62 W. 730 000 FEET



1 Mile
5 000 Feet
Scale 1:20 000

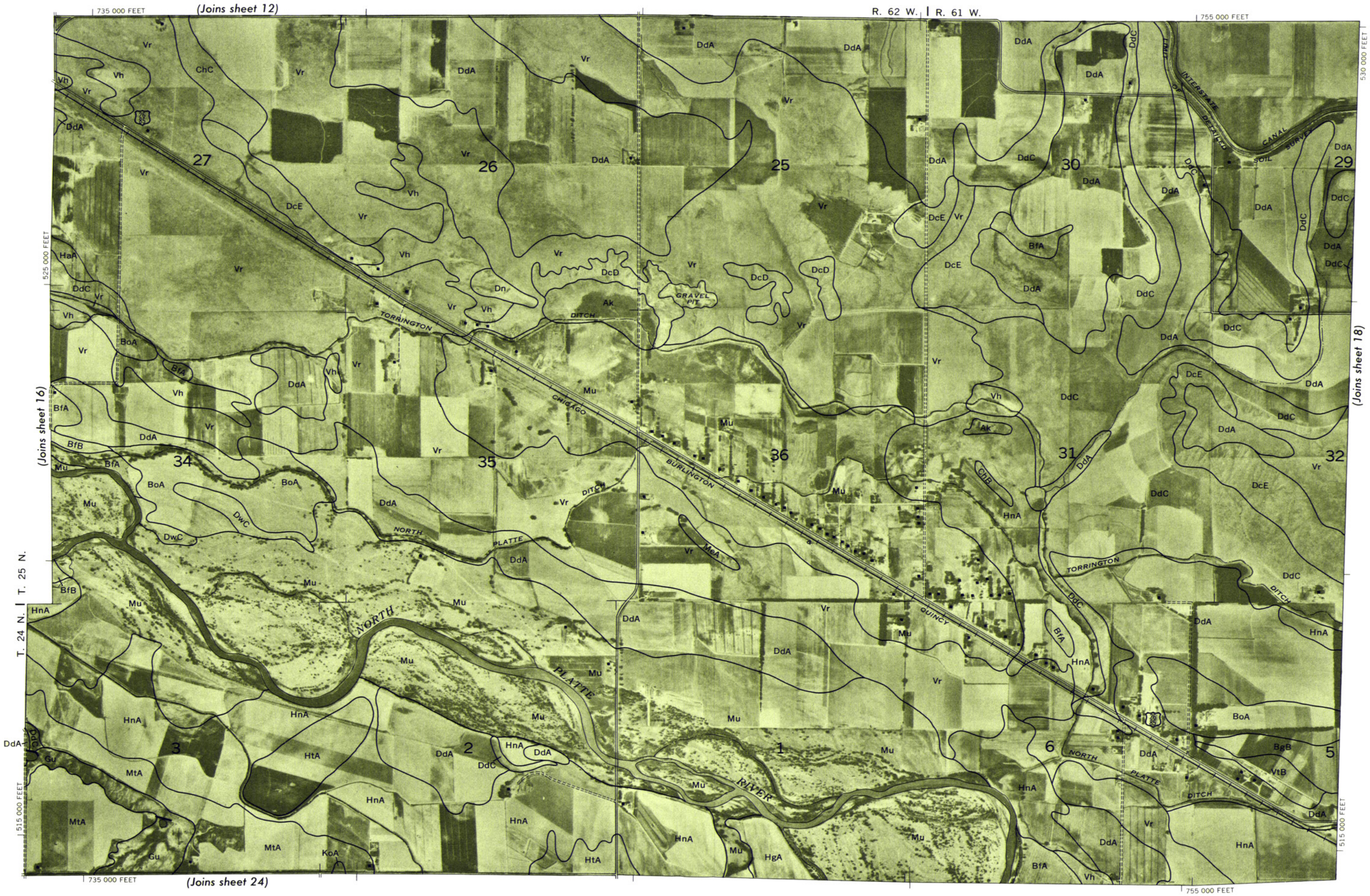
(Joins sheet 15)

(Joins sheet 17)

(Joins sheet 23)

715 000 FEET 730 000 FEET

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 18

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 19

19

785 000 FEET

805 000 FEET

530 000 FEET

520 000 FEET

515 000 FEET

N

R. 60 W.

T. 25 N.

T. 24 N.

(Joins sheet 18)

(Joins sheet 26)

SIOUX COUNTY, NEBRASKA

INTERSTATE CANAL

LATERAL NO. 1

LATERAL NO. 2

LIMIT OF DETAILED SOIL SURVEY

31 32 33 34

6 5 4 3

Vh Vr DdA DdC

1 Mile

5 000 Feet

0 0

Scale 1:20 000

1/4 1 000

1/2 2 000

3/4 3 000

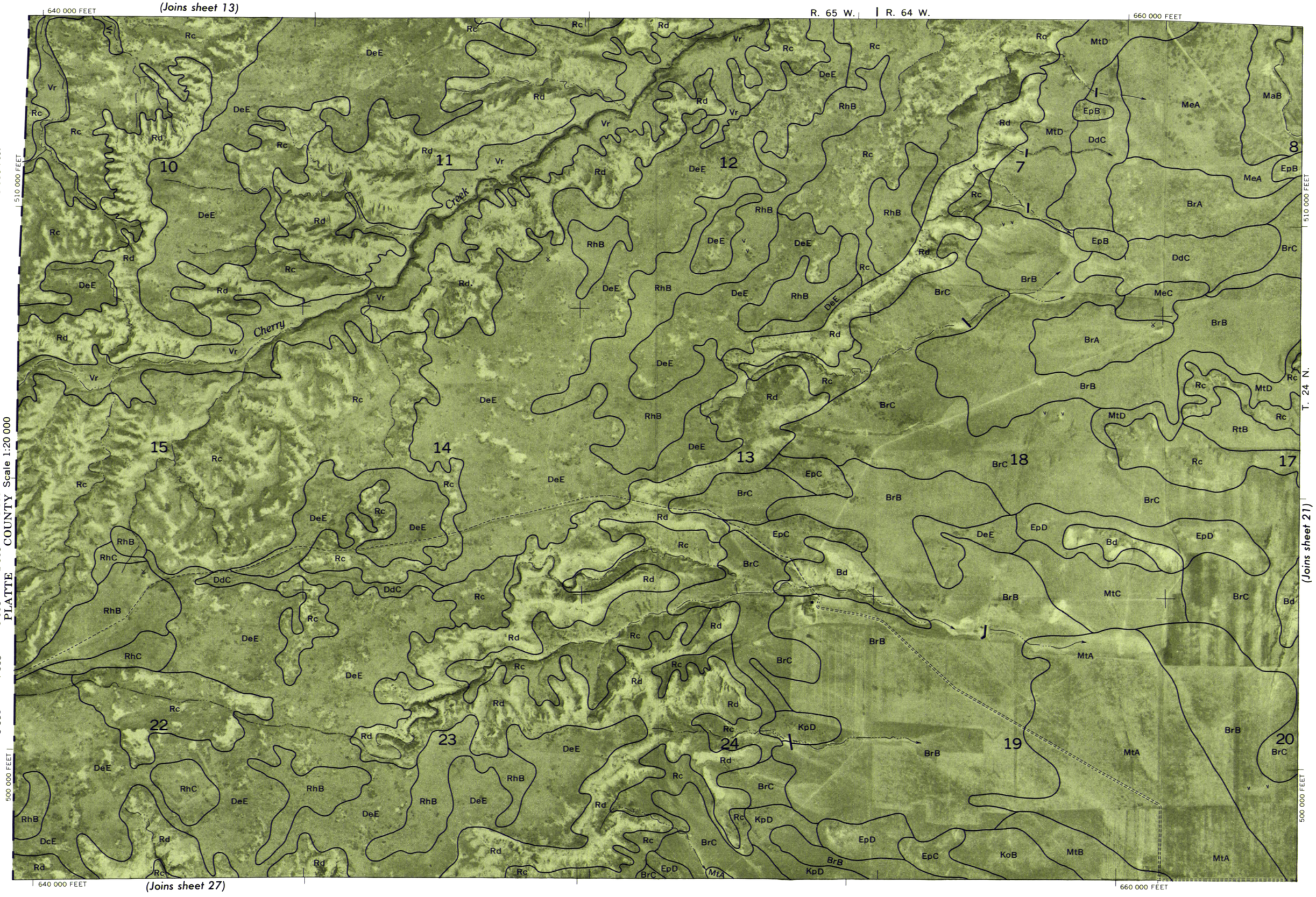
4 000

1 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 2

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



N

1 Mile

5 000 Feet

0

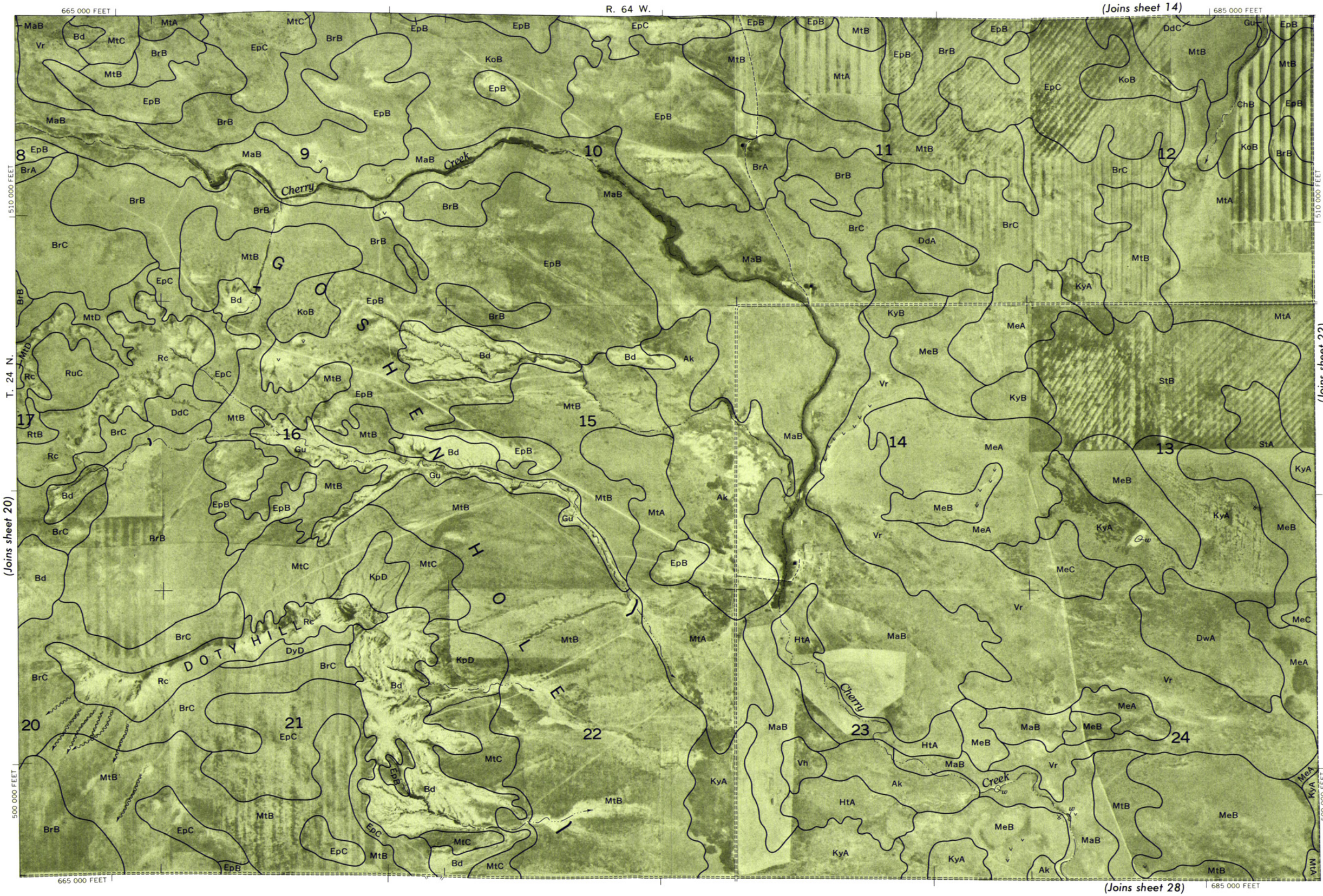
1:20 000

PLATTE COUNTY Scale 1:20 000

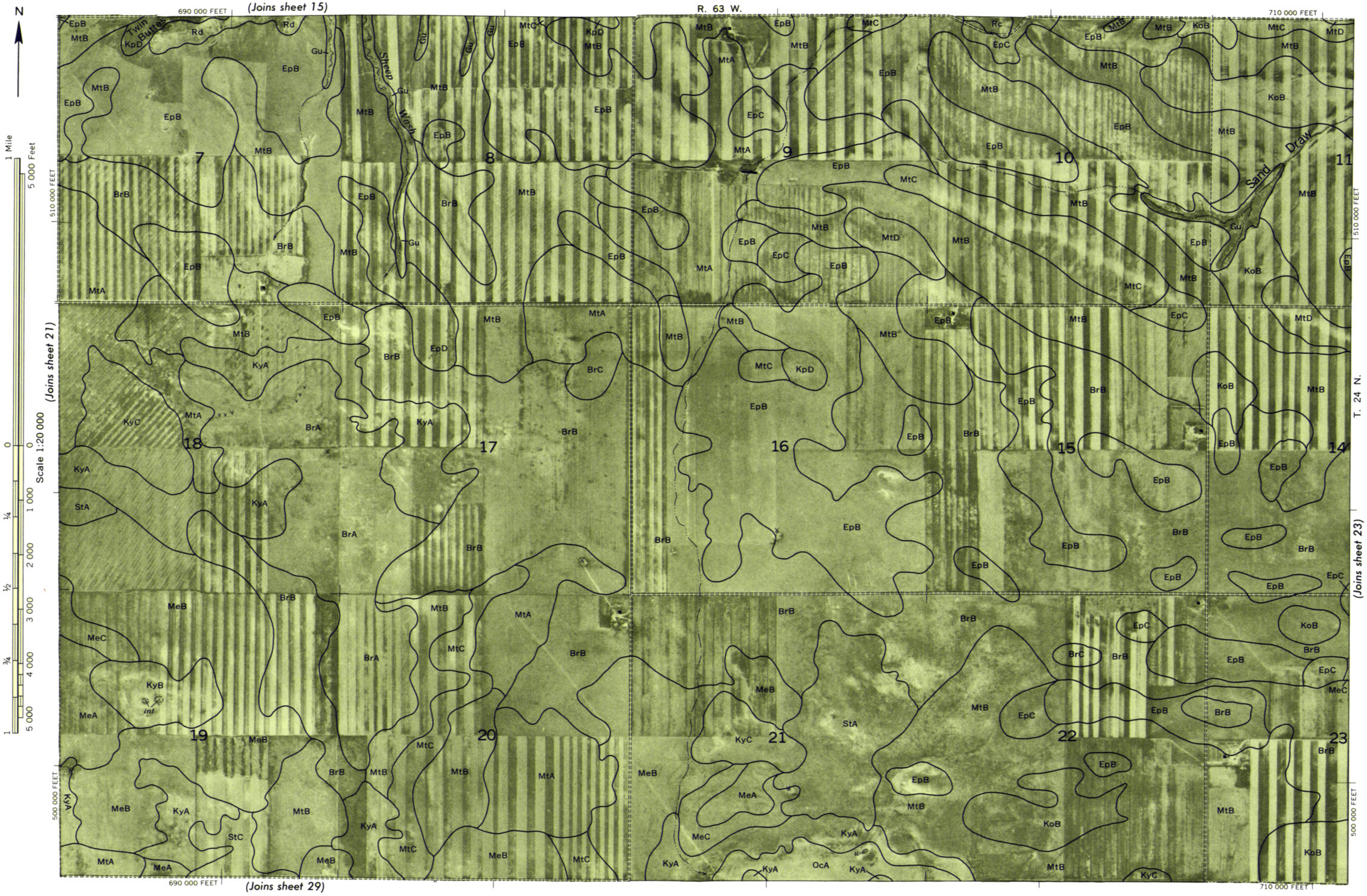
0 1 000 2 000 3 000 4 000 5 000

0 ¼ ½ ¾ 1

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 23

23

N

R. 63 W. | R. 62 W.

715 000 FEET

730 000 FEET

(Joins sheet 16)

510 000 FEET

500 000 FEET

T. 24 N.

(Joins sheet 22)

(Joins sheet 24)

(Joins sheet 30)

Sand Draw

Draw

Herflen Draw

Angel Draw

Three Buttes

LARAMIE CANAL

11 12 7 8 9

14 13 18 17 16

23 24 19 20 21

1 Mile

5 000 Feet

0 0

Scale 1:20 000

1 5 000

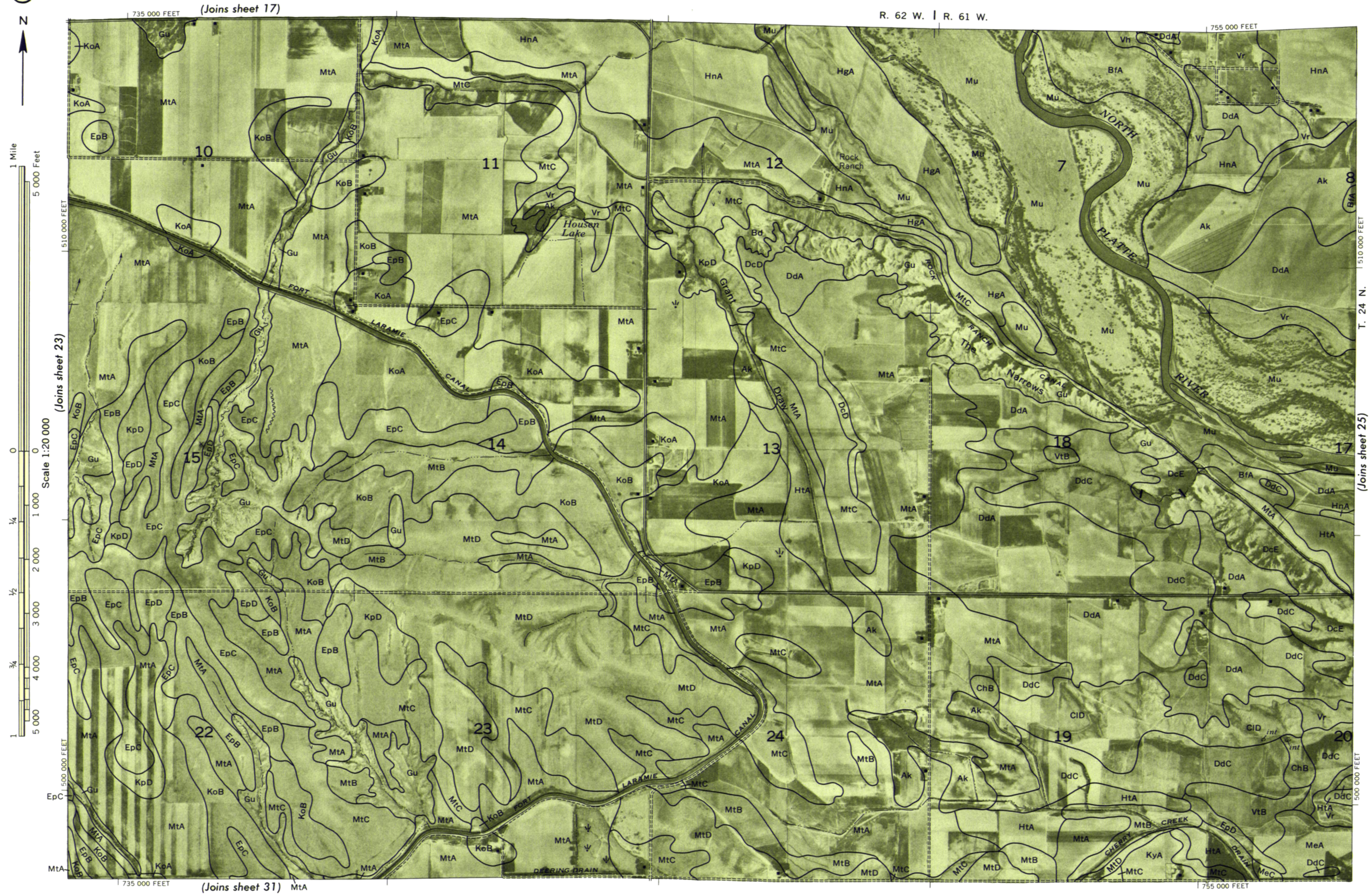
¼ 1 000

½ 2 000

¾ 4 000

1 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

Scale 1:20 000

1 Mile 5 000 Feet

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

785 000 FEET

805 000 FEET

510 000 FEET

500 000 FEET

515 000 FEET

(Joins sheet 19)

(Joins sheet 25)

(Joins sheet 33)

R. 60 W.

T. 24 N.

SIOUX COUNTY NEBRASKA

7 8 9 10

18 17 16 15

19 20 21 22

Vh Vr DdA Ak BfA HaA GbA Mu DdC

NORTH PLATTE DITCH

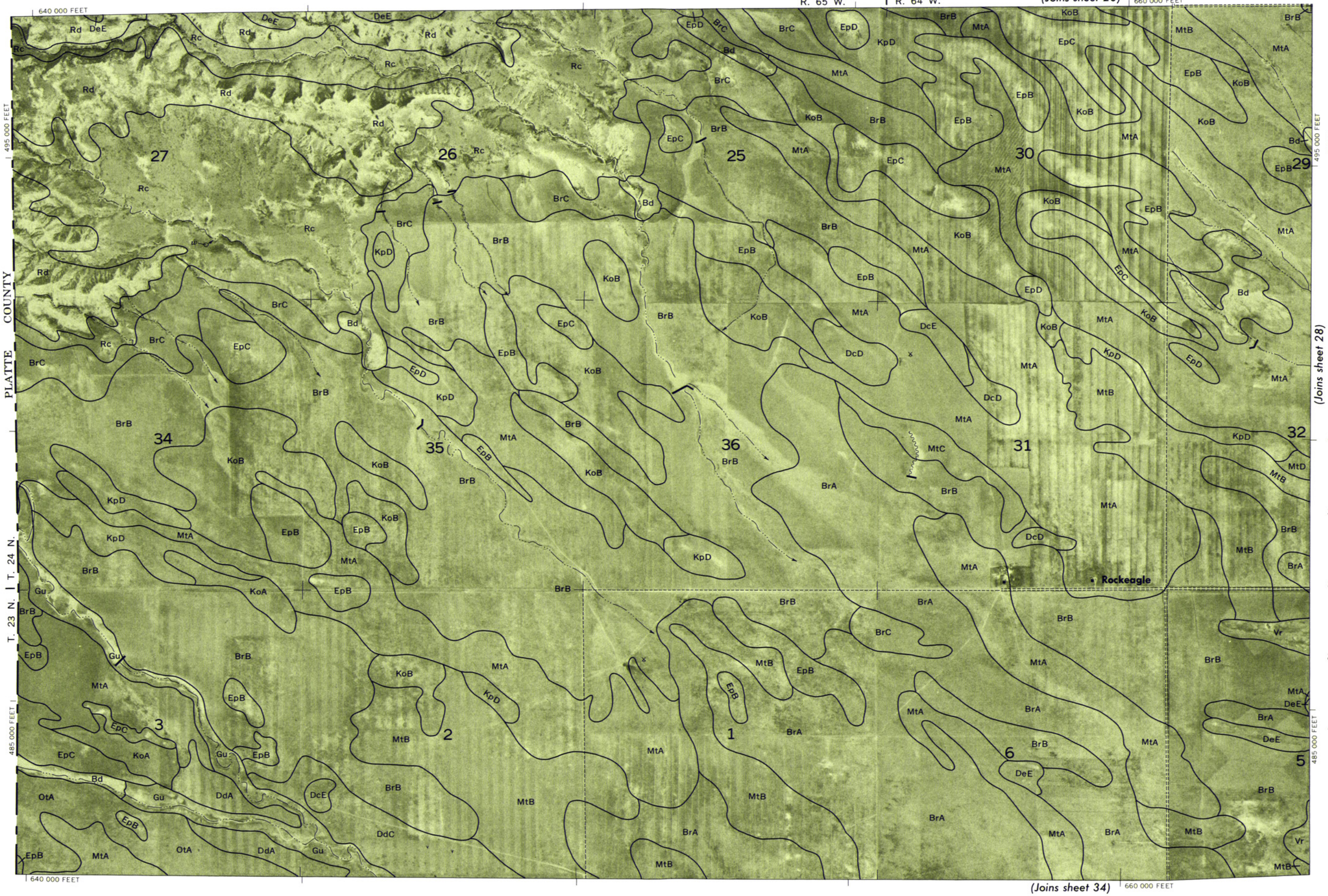
LATERAL NO. 1

CHICAGO BURLINGTON & QUINCY

NORTH PLATTE R.

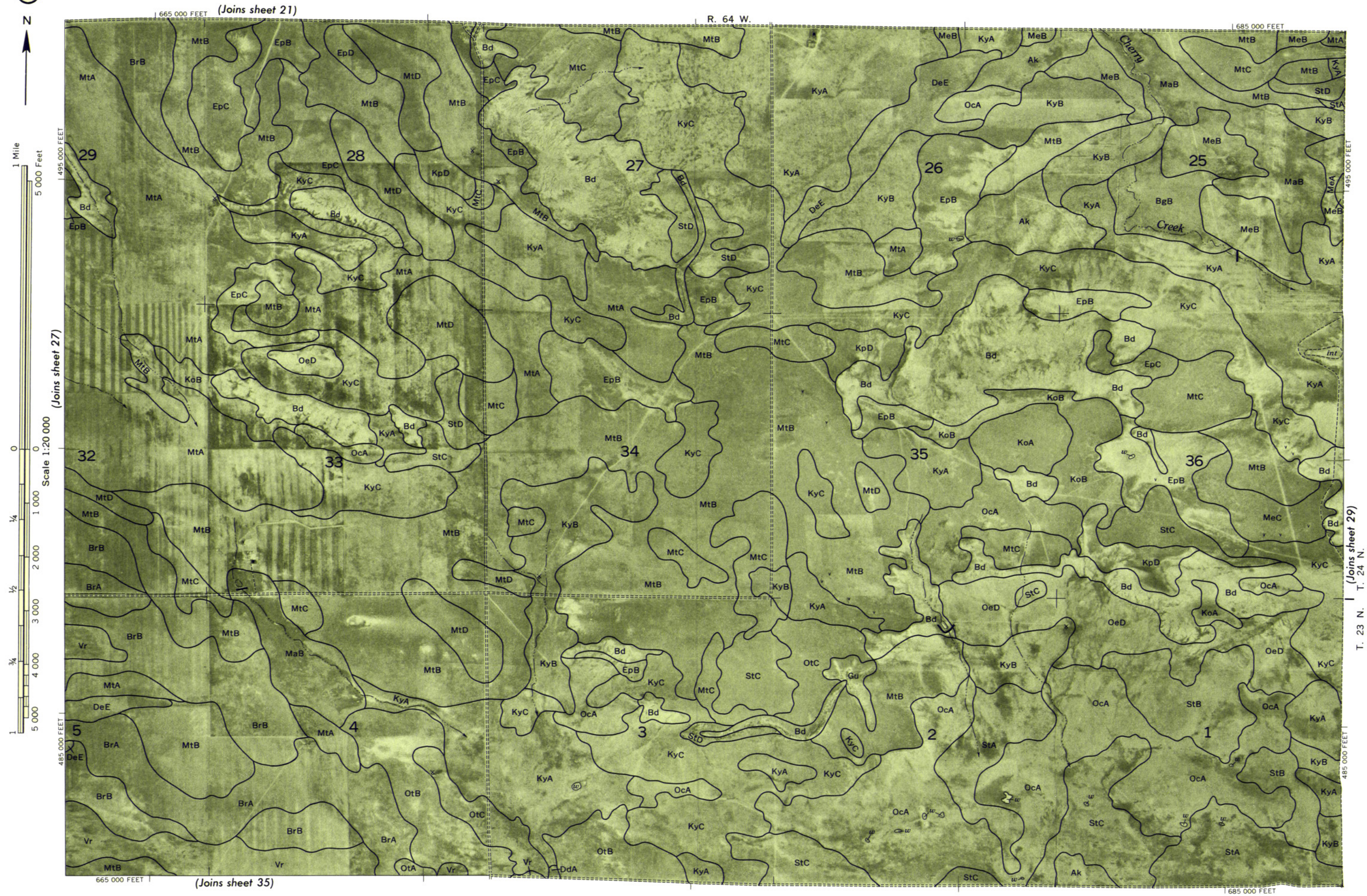
26

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 192/ North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 28



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 29

29

690 000 FEET

R. 63 W.

(Joins sheet 22)

710 000 FEET

N

495 000 FEET

1 Mile

5 000 Feet

(Joins sheet 28)

(Joins sheet 30)

T. 24 N.

T. 23 N.

485 000 FEET

Whitehorse Butte

intermittent

intermittent

CHERRY CREEK DRAIN

FORT LARAMIE CANAL

LARAMIE CANAL

Scale 1:20 000

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

(Joins sheet 36)

690 000 FEET

710 000 FEET

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 3

3

N

640 000 FEET

R. 65 W. | R. 64 W.

(Joins sheet 1)

660 000 FEET

560 000 FEET

PLATTE COUNTY

T. 25 N. | T. 26 N.

550 000 FEET

(Joins sheet 4)

(Joins sheet 8)

1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

(Joins sheet 23)

715 000 FEET

R. 63 W. | R. 62 W.

730 000 FEET

495 000 FEET

485 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

(Joins sheet 29)

(Joins sheet 31)

(Joins sheet 37)

T. 23 N. | T. 24 N.

CANAL

LARAMIE FORT UNION PACIFIC DRAIN

PACIFIC CREEK

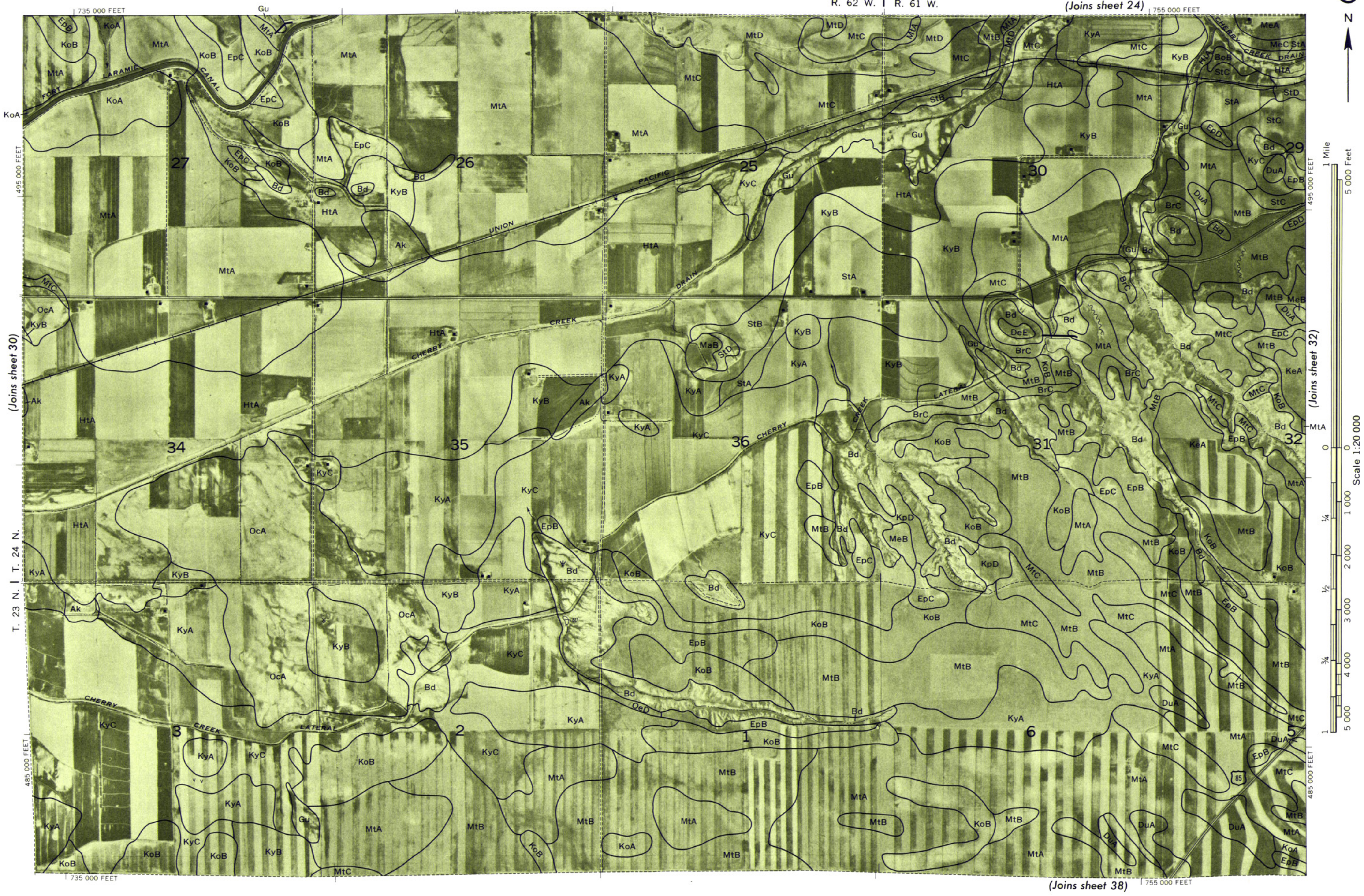
CHERRY CREEK

LATERAL

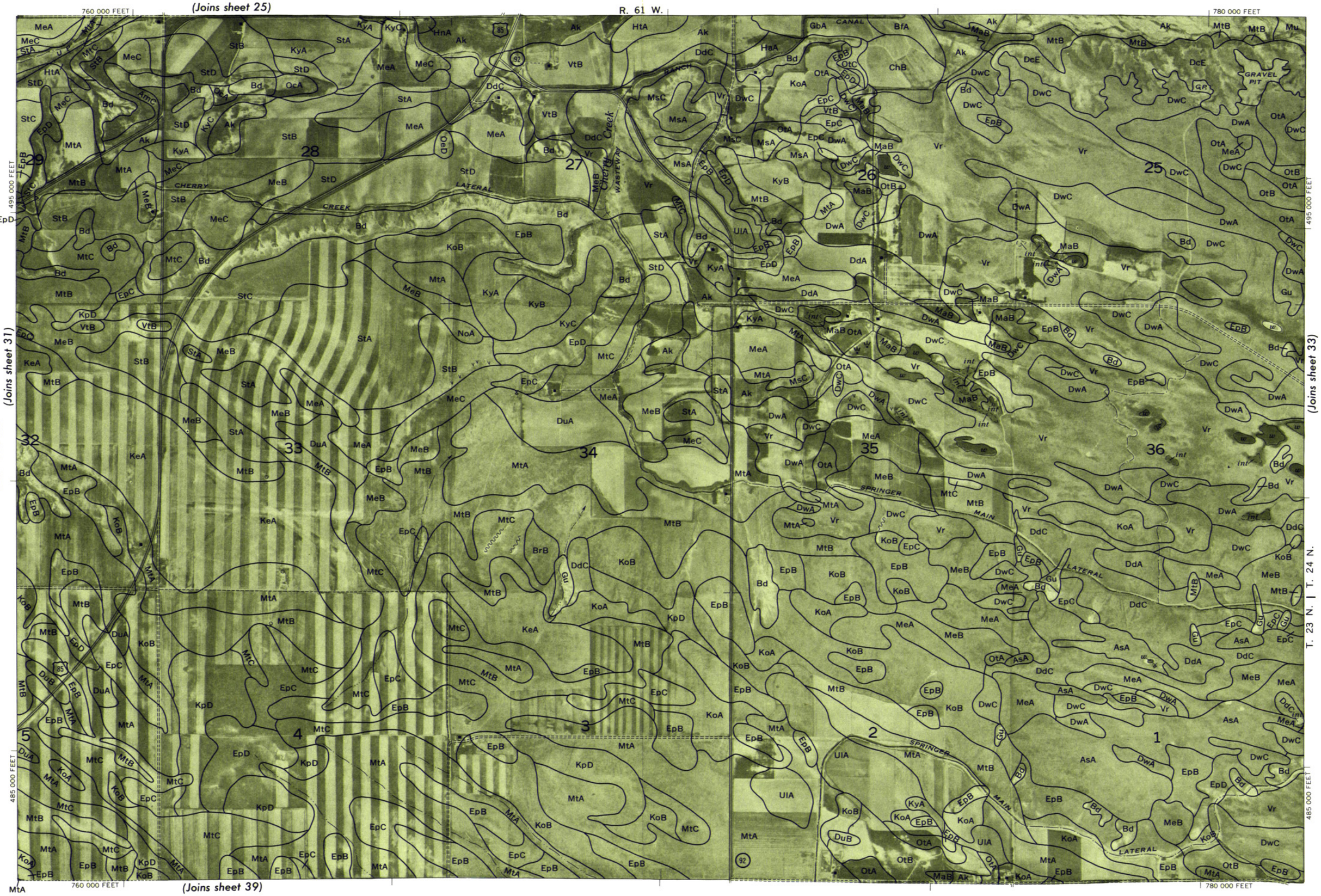
PERCHAL DRAIN

Heldt

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

(Joins sheet 26)

785 000 FEET

R. 60 W.

805 000 FEET

(Joins sheet 32)

T. 23 N. | T. 24 N.

495 000 FEET

485 000 FEET

(Joins sheet 40)

33

N

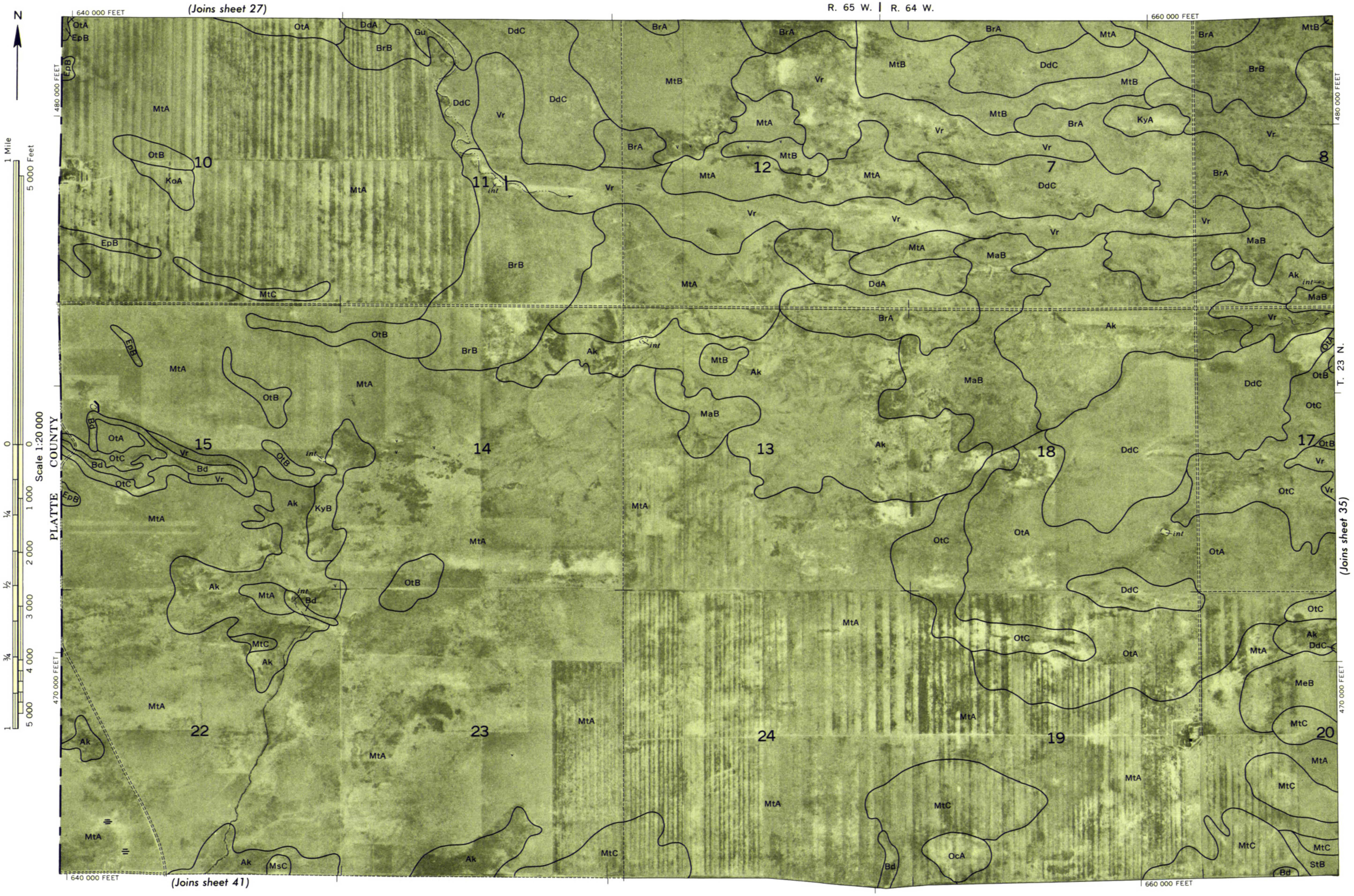
1 Mile

5 000 Feet

Scale 1:20 000

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING, — SHEET NUMBER 35

35

N

665 000 FEET

480 000 FEET

R. 64 W.

(Joins sheet 28)

685 000 FEET

T. 23 N.

(Joins sheet 34)

(Joins sheet 36)

470 000 FEET

(Joins sheet 42)

1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

Scale 1:20 000

1 Mile 5 000 Feet

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

690 000 FEET

710 000 FEET

480 000 FEET

470 000 FEET

R. 63 W.

T. 23 N.

(Joins sheet 29)

(Joins sheet 35)

(Joins sheet 37)

(Joins sheet 43)

BOX ELDER DRAIN

FORT LARAMIE CANAL

CHERRY CREEK

HALTER DRAIN

LARAMIE FORT MYERS DRAIN

LARAMIE FORT MYERS CANAL

7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

AmA AmC Ak Bd DdA DdC DuA DuB HtA KyA KyB KyC MeA MeB MeC MsA MsC MtA MtB MtC OcA OtA OtB StA StB StC StD UlA UlB UlC VtB Vr int

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.

37

R. 63 W. | R. 62 W.

715 000 FEET

730 000 FEET

480 000 FEET

470 000 FEET

T. 23 N.

(Joins sheet 30)

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 44)

N

1 Mile

5 000 Feet

Scale 1:20 000

1 0 1 000 2 000 3 000 4 000 5 000

¼ ½ ¾

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

R. 62 W. | R. 61 W.

T. 23 N.

735 000 FEET

755 000 FEET

480 000 FEET

470 000 FEET

(Joins sheet 31)

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 45)

1 Mile

5 000 Feet

Scale 1:20 000

0 0

¼ 1 000

½ 2 000

¾ 4 000

1 5 000

10 11 12 7 8

15 14 13 18 17

22 23 24 19 20

KoB KyA KyB KyC KyD MtA MtB MtC EpB EpC KoA DuA DeE StD StC Bd OcA KeA Ak int

LATERAL

LAYTON DRAIN

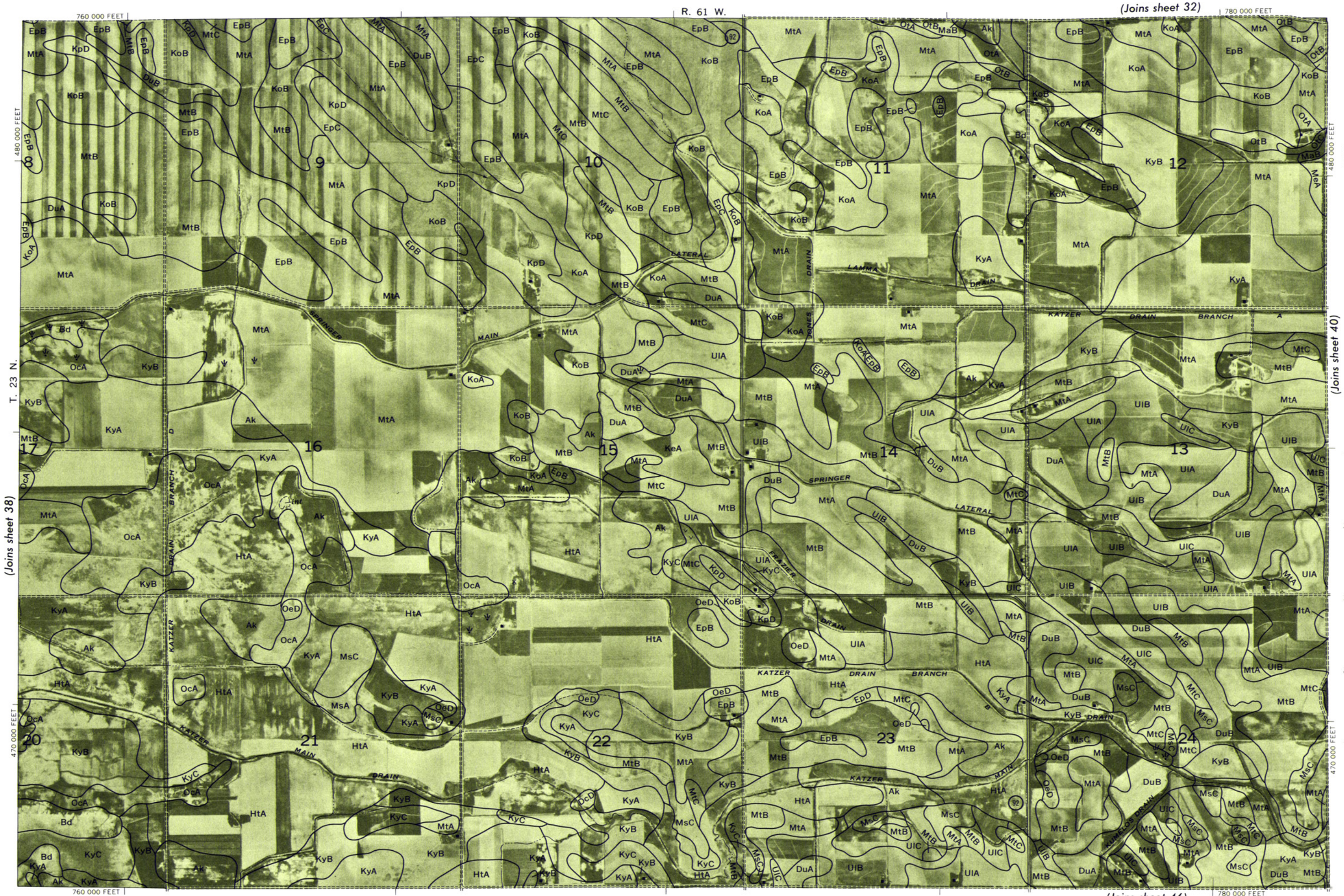
BRANCH A

MAIN

SPRINGER

KATZER

DRAIN



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 4

4

N

665 000 FEET

(Joins sheet 2)

R. 64 W.

685 000 FEET

560 000 FEET

(Joins sheet 3)

550 000 FEET

665 000 FEET

(Joins sheet 9)

685 000 FEET

(Joins sheet 5)

T. 25 N. | T. 26 N.

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

FORT LARAMIE NATIONAL MONUMENT

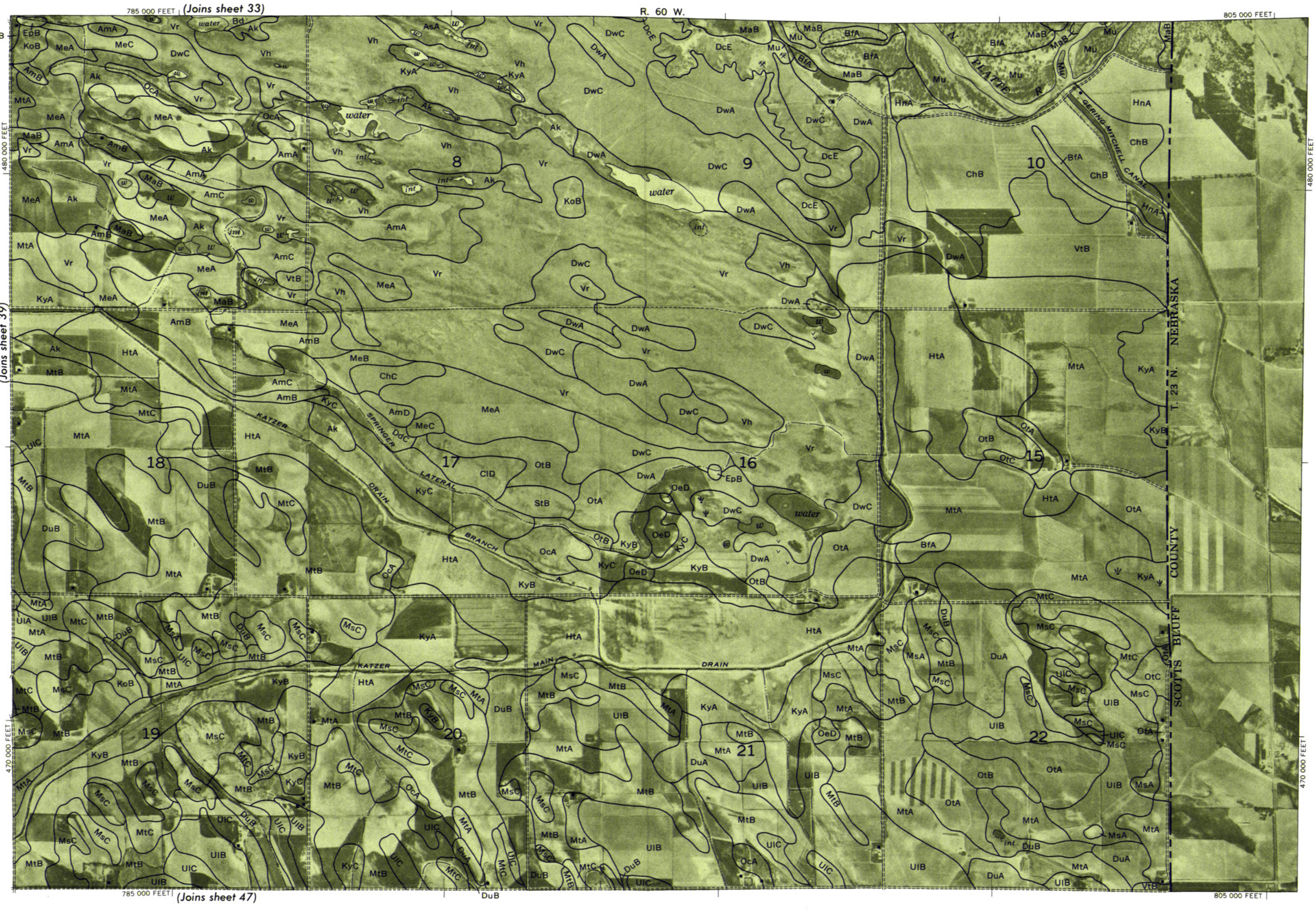
LARAMIE RIVER

NORTH PLATTE RIVER

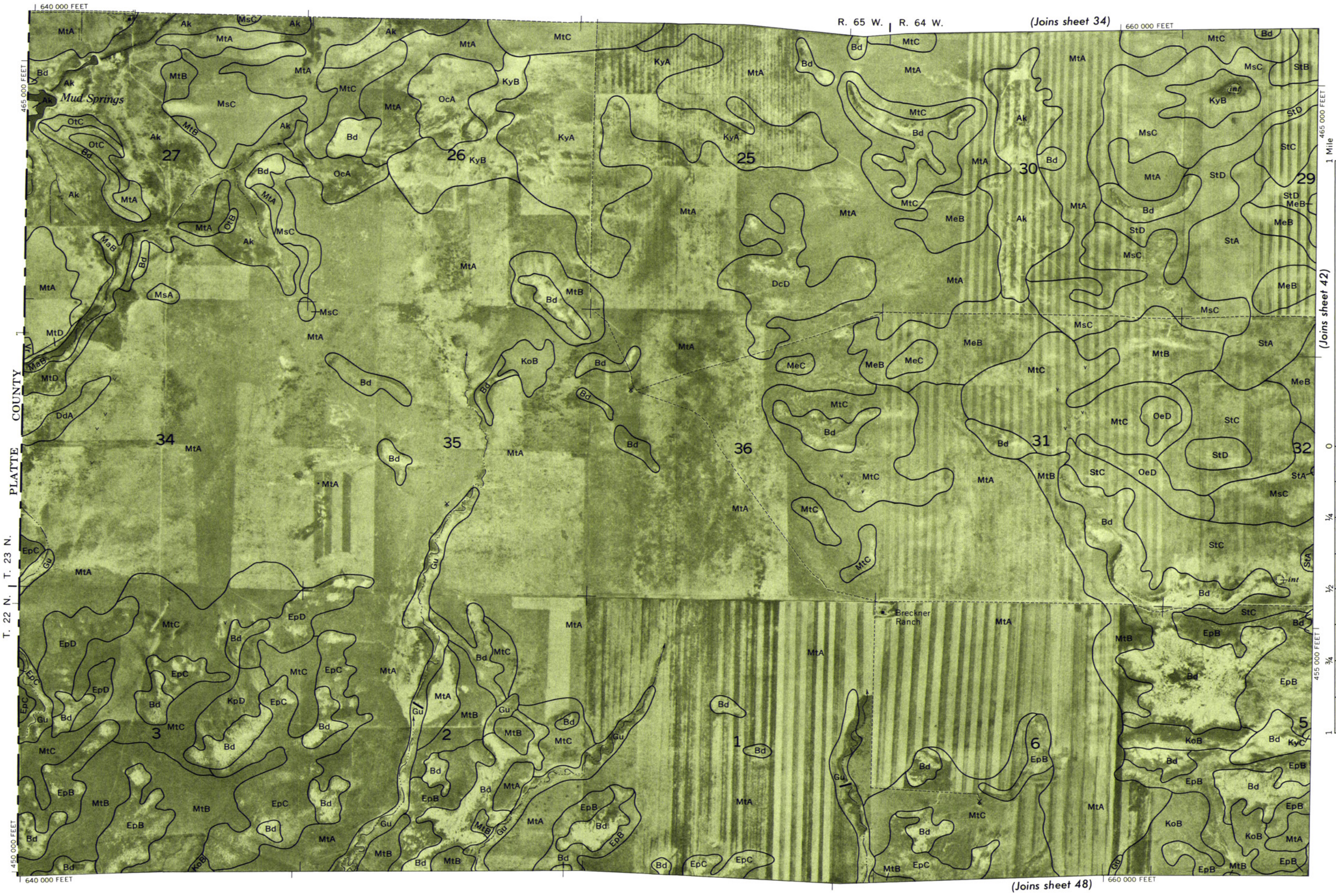
FORT LARAMIE CANAL

CHICAGO, BURLINGTON & QUINCY

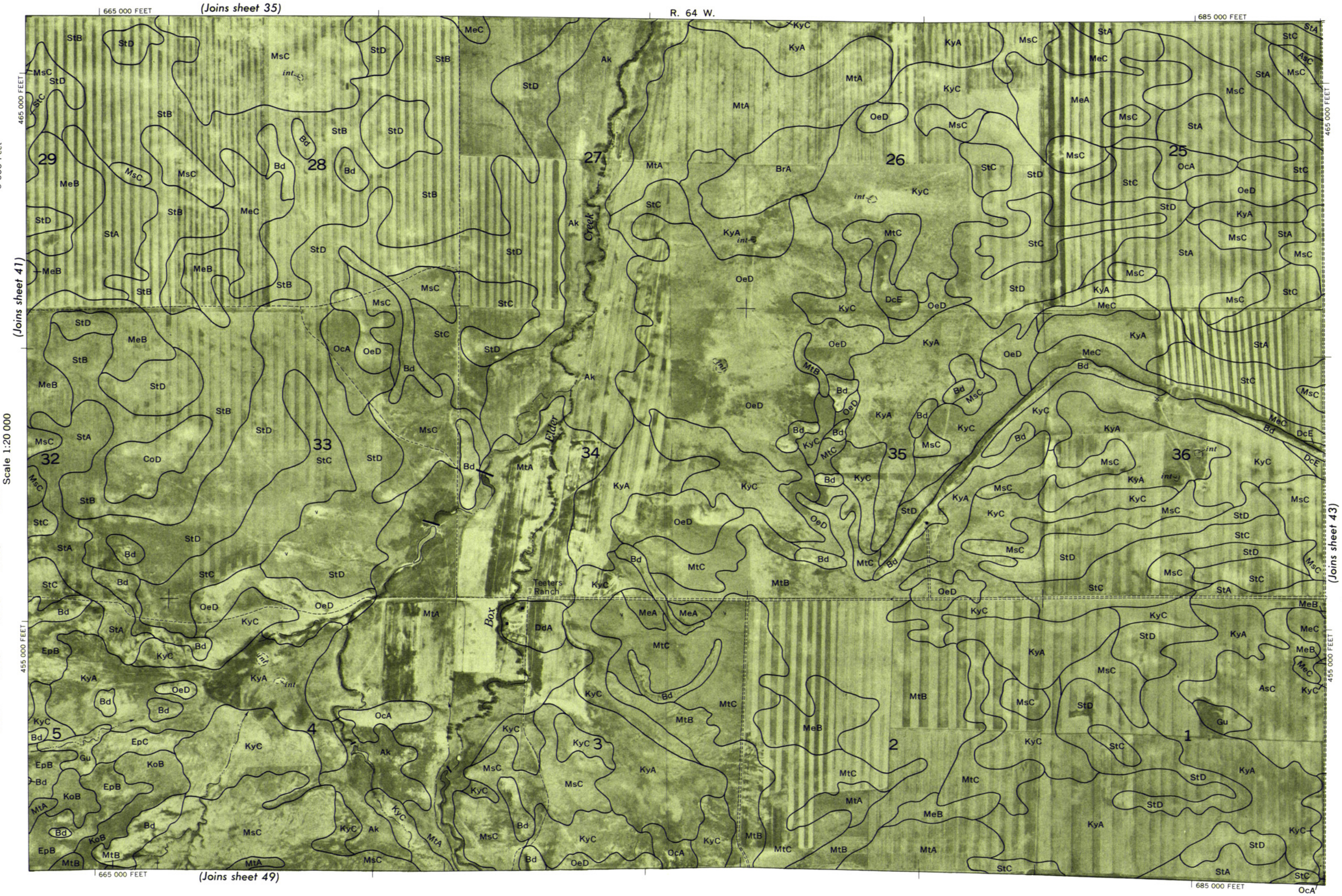
Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



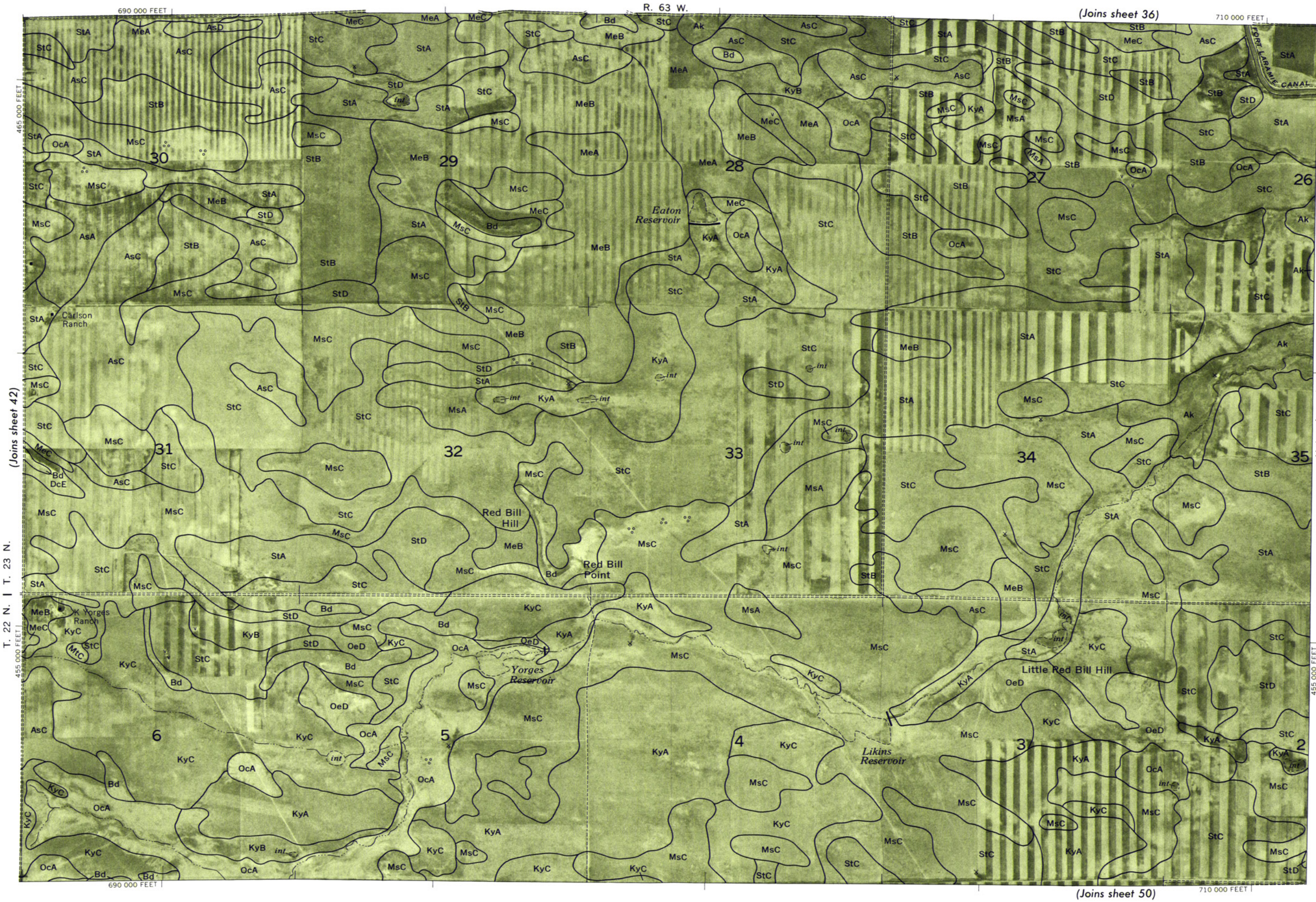
Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



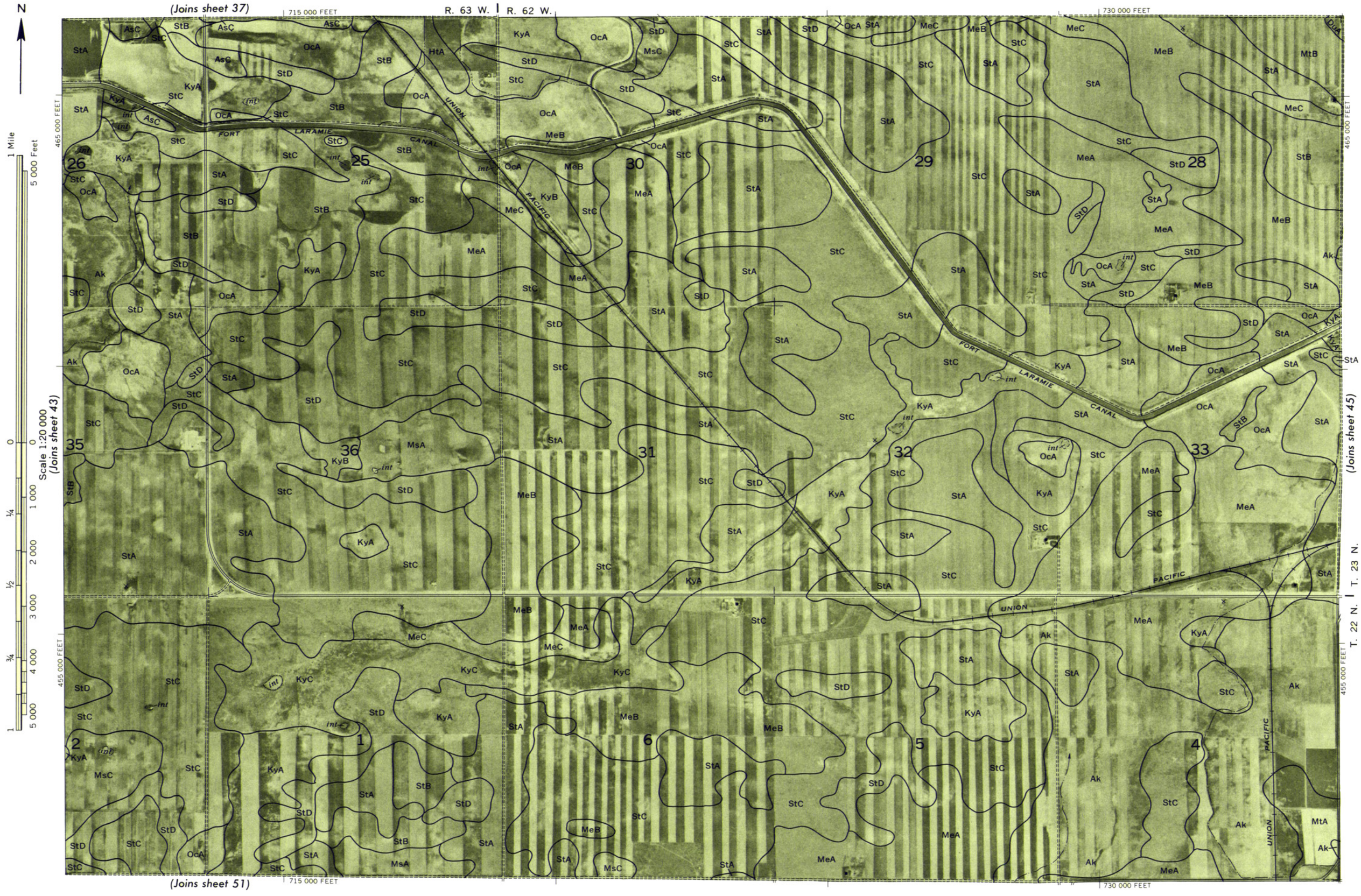
Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

R. 62 W. | R. 61 W.

735 000 FEET

755 000 FEET

465 000 FEET

455 000 FEET

T. 23 N.

T. 22 N.

N

(Joins sheet 38)

(Joins sheet 44)

(Joins sheet 46)

(Joins sheet 52)

Yoder

Silver Tip

Hillview Home

Horse Creek

GOSHEN HOLE MAIN DITCH LATERAL

SPRINGER MAIN LATERAL

FORT LARAMIE CANAL

UNION PACIFIC

EAST HOLE DITCH

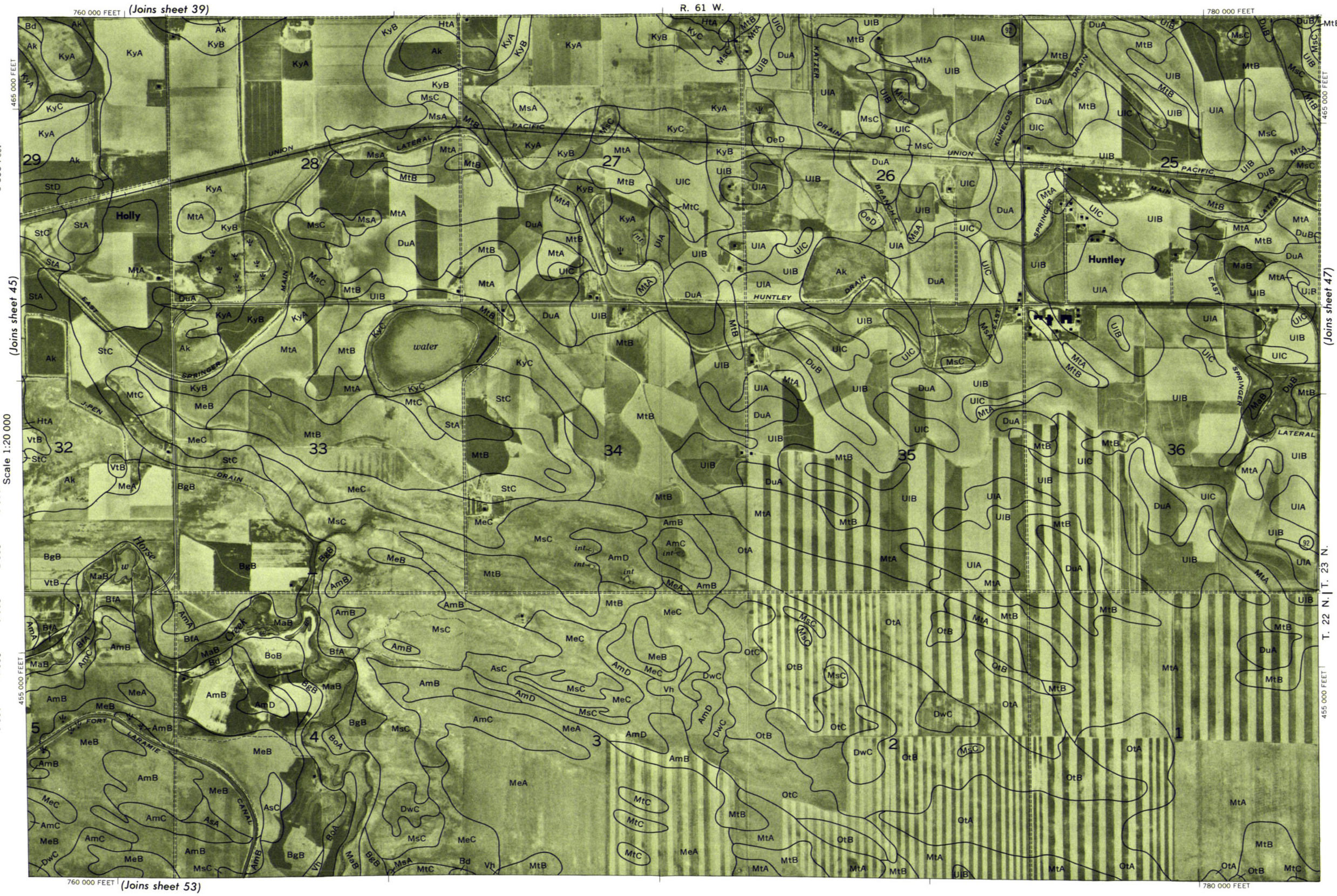
J-PEN DRAIN

1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 47

47

(Joins sheet 40)

(Joins sheet 46)

(Joins sheet 54)

785 000 FEET

805 000 FEET

465 000 FEET

455 000 FEET

R. 60 W.

T. 23 N.

T. 22 N.

N

1 Mile

5 000 Feet

Scale 1:20 000

NEBRASKA

SCOTTS BLUFF COUNTY

Rattlesnake Hill

Horse Creek

Packer Lake

Canal

SPRINGER EAST MAIN LATERAL

SPRINGER EAST LATERAL

MAIN LATERAL

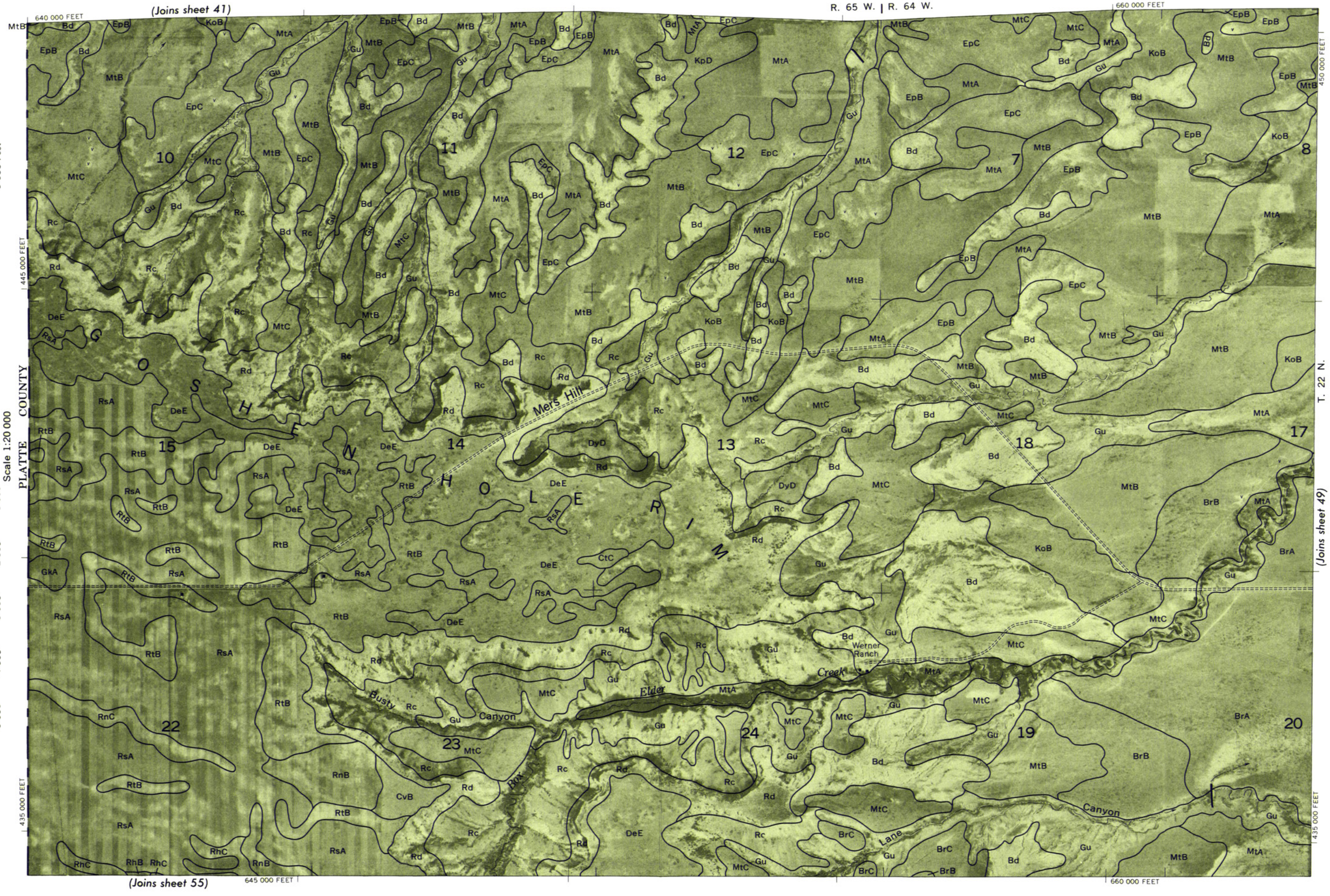
UNION PACIFIC

MCELHANEY DRAIN

NORTH HORSE CREEK

PACKER DITCH

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

665 000 FEET

R. 64 W.

(Joins sheet 42)

685 000 FEET

450 000 FEET

N

T. 22 N.

(Joins sheet 48)

(Joins sheet 50)

435 000 FEET

Glomill Reservoir

Box Elder Creek

intermittent

Yorges Ranch

Bogville Ranch

Corn Creek

1 Mile 5 000 Feet 0 0 1:20 000 Scale 1:20 000

(Joins sheet 56)

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

690 000 FEET

(Joins sheet 43)

R. 63 W.

710 000 FEET

450 000 FEET

T. 22 N.

(Joins sheet 51)

435 000 FEET

(Joins sheet 49)

(Joins sheet 57)

Scale 1:20 000

1 Mile — 5 000 Feet

0 — 0

¼ — 1 000

½ — 2 000

¾ — 3 000

1 — 4 000

5 000

Millies Hill

E. G. House Ranch

House Ranch

7 8 9 10 11

18 17 16 15 14

19 20 21 22 23

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.

R. 63 W. | R. 62 W.

715 000 FEET

730 000 FEET

(Joins sheet 44)

450 000 FEET

T. 22 N.

(Joins sheet 50)

(Joins sheet 52)

435 000 FEET

(Joins sheet 58)

N

1 Mile

5 000 Feet

Scale 1:20 000

Day Ranch

Greasewood Ranch

Goodland

Bump-Sullivan Reservoir

Bump-Sullivan Reservoir

PACIFIC

UNION

Com. Ditch

Hawk Springs Creek

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

R. 62 W. | R. 61 W.

735 000 FEET

755 000 FEET

450 000 FEET

435 000 FEET

T. 22 N.

(Joins sheet 45)

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 59)

1 Mile

5 000 Feet

Scale 1:20 000

GOSHEN HOLE RESERVOIR

SPRINGER WILDLIFE MANAGEMENT UNIT

Goshen Hole Reservoir

SPRINGER WILDLIFE MANAGEMENT UNIT

Bump-Sullivan Reservoir

Little Willow Reservoir

Horse Creek

LARAMIE CANAL

SPRINGER DITCH

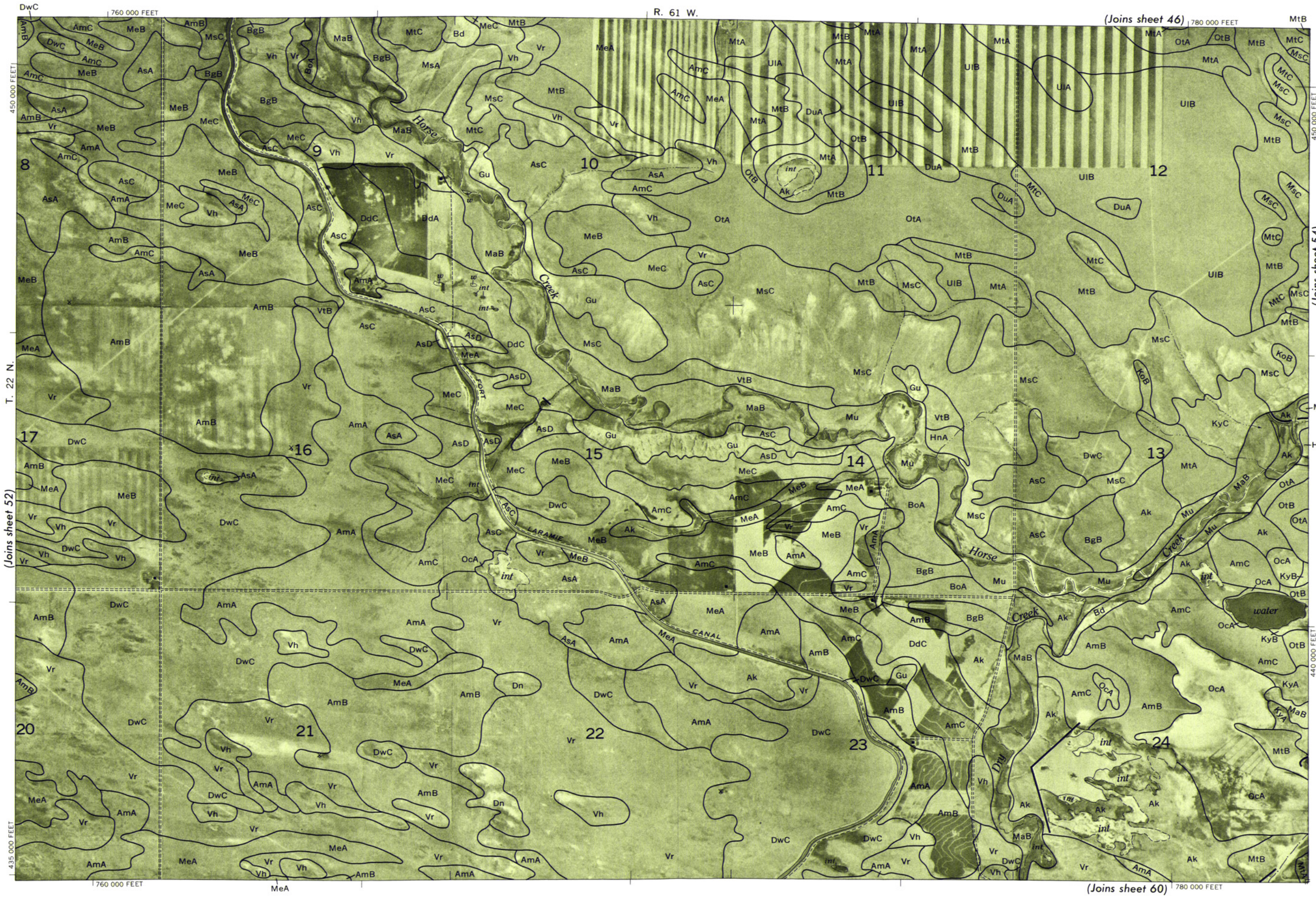
LEWIS DITCH

UNION PACIFIC

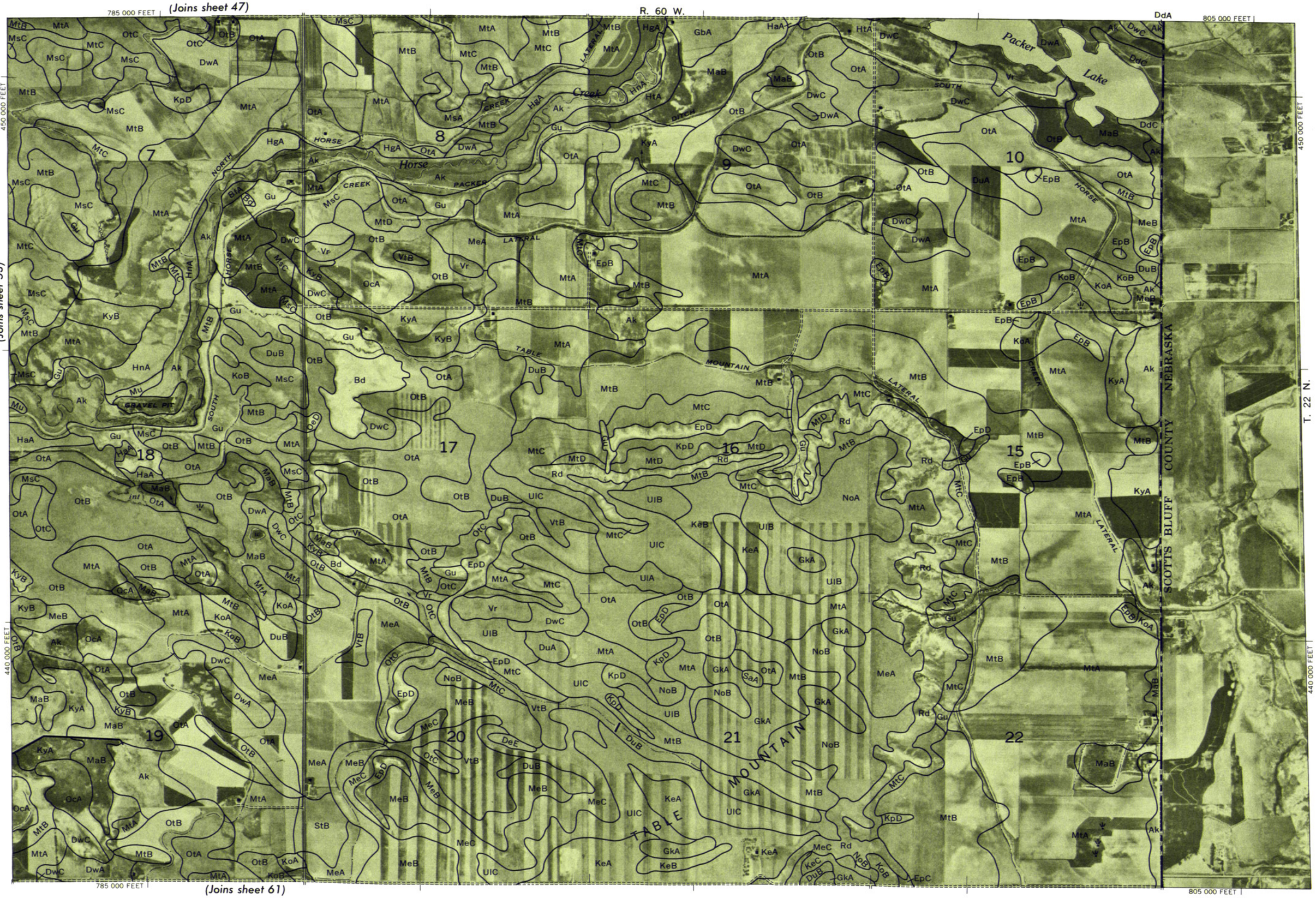
BUMP SULLIVAN DITCH

GRAVEL PIT

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

55

N

645 000 FEET

R. 65 W. | R. 64 W.

660 000 FEET

(Joins sheet 48)

430 000 FEET

PLATTE COUNTY

T. 22 N. | T. 21 N.

420 000 FEET

(Joins sheet 56)

(Joins sheet 62)

GOSHEN HOLE RIM

GOSHEN HOLE

Elder Creek

Cedar Canyon

Box Elder Canyon

Lane Canyon

Barns Canyon

Sawmill Canyon

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

R. 64 W.

665 000 FEET

685 000 FEET

430 000 FEET

420 000 FEET

(Joins sheet 49)

(Joins sheet 55)

(Joins sheet 57)

(Joins sheet 63)

T. 21 N. | T. 22 N.

Scale 1:20 000

1 Mile

5 000 Feet

0 1 000 2 000 3 000 4 000 5 000

1/4 1/2 3/4 1

Canyon

Barns

Sawmill

YBO HILL

Moore Canyon

Sam Creek

Ybo Creek

Josh Creek

Smith Ranch

29 28 27 26 25

32 33 39 35 36

5 4 3 2 1

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 57

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone, 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 58

58

N

(Joins sheet 51)

715 000 FEET

R. 63 W. | R. 62 W.

730 000 FEET

Bump-Sullivan Reservoir

Corn Creek

HAWK SPRINGS

DITCH

WOODARD DITCH

SINNARD DITCH

Fonda

Lone Tree Creek

26 25 30 29 28

35 36 31 32 33

2 1 6 5 4

T. 21 N. | T. 22 N.

430 000 FEET

420 000 FEET

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 65)

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 59

59

N

735 000 FEET

755 000 FEET

R. 62 W. | R. 61 W.

(Joins sheet 52)

(Joins sheet 58)

(Joins sheet 60)

(Joins sheet 66)

430 000 FEET

420 000 FEET

T. 21 N. | T. 22 N.

WILDLIFE RESERVATION BOUNDARY

Fonda

Lone Tree Creek

Dunn Reservoir

Hughes Reservoir

intermittent

SPRINGER DITCH

DITCH

SINWARD

UNION PACIFIC

BUMP-SULLIVAN

LITTLE WILLOW Creek

Horse Creek

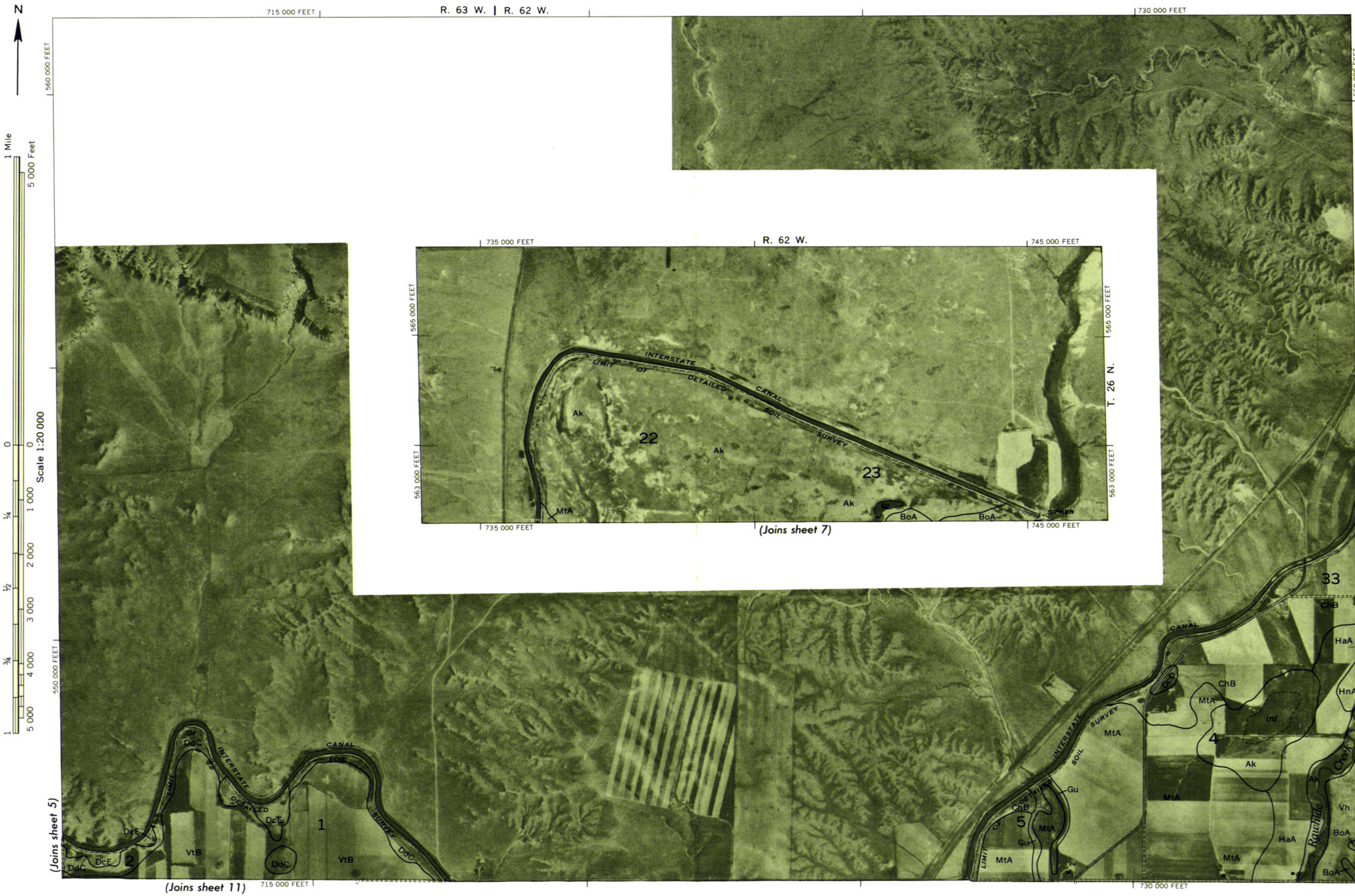
1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 6



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

Scale 1:20 000

1 Mile 5 000 Feet

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

760 000 FEET

780 000 FEET

430 000 FEET

420 000 FEET

435 000 FEET

(Joins sheet 53)

(Joins sheet 59)

(Joins sheet 61)

(Joins sheet 67)

R. 61 W.

T. 21 N. | T. 22 N.

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 61

61

(Joins sheet 54)

(Joins sheet 60)

(Joins sheet 68)

785 000 FEET

805 000 FEET

435 000 FEET

420 000 FEET

R. 60 W.

T. 22 N.

T. 21 N.

N

1 Mile

5 000 Feet

Scale 1:20 000

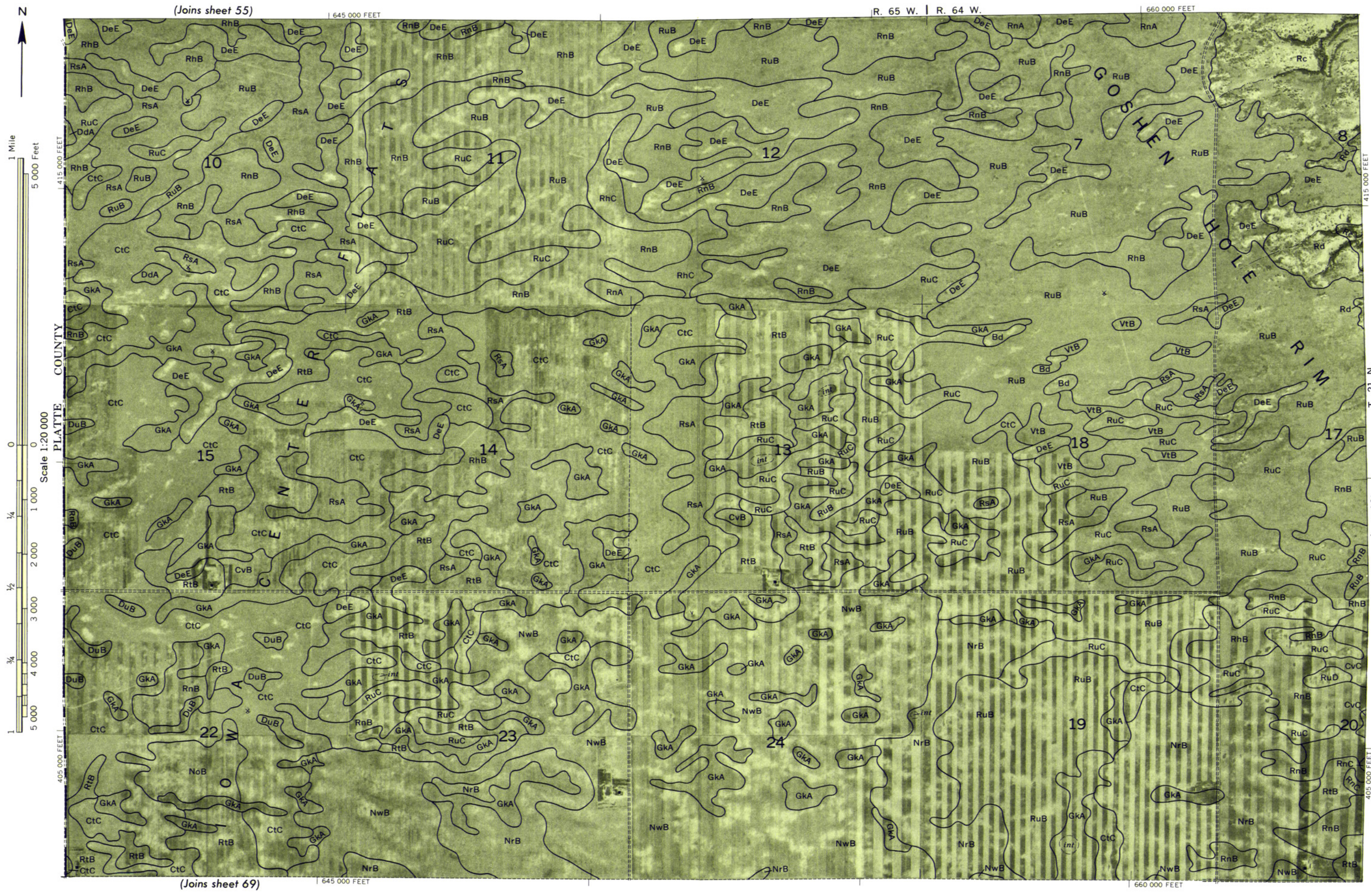
0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

NEBRASKA

SCOTTS BLUFF COUNTY

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

63

N

R. 64 W.

(Joins sheet 56)

665 000 FEET

685 000 FEET

415 000 FEET

T. 21 N.

(Joins sheet 62)

(Joins sheet 64)

(Joins sheet 70)

GOSHEN HOLE

RIM

Canyon

Creek

Josh

Little Josh

Sugar Bowl Rock

Steamboat Rock

Hoyt

8 9 10 11 12 13 14 15 16 17 20 21 22 23 24

BrA BrB BrC AsC CvC CvB DdA DdC DeE DyD GkA Gu MsC MtA MtB MtC NrB OtA RhB RhC RhD RnB RnC RtB RuB RuC RuD Rc Rd Vr Ybo

1 Mile 5 000 Feet

Scale 1:20 000

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

690 000 FEET

(Joins sheet 57)

R. 63 W.

710 000 FEET

415 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 63)

T. 21 N.

(Joins sheet 65)

405 000 FEET

690 000 FEET

(Joins sheet 71)

710 000 FEET

Hoyt Creek

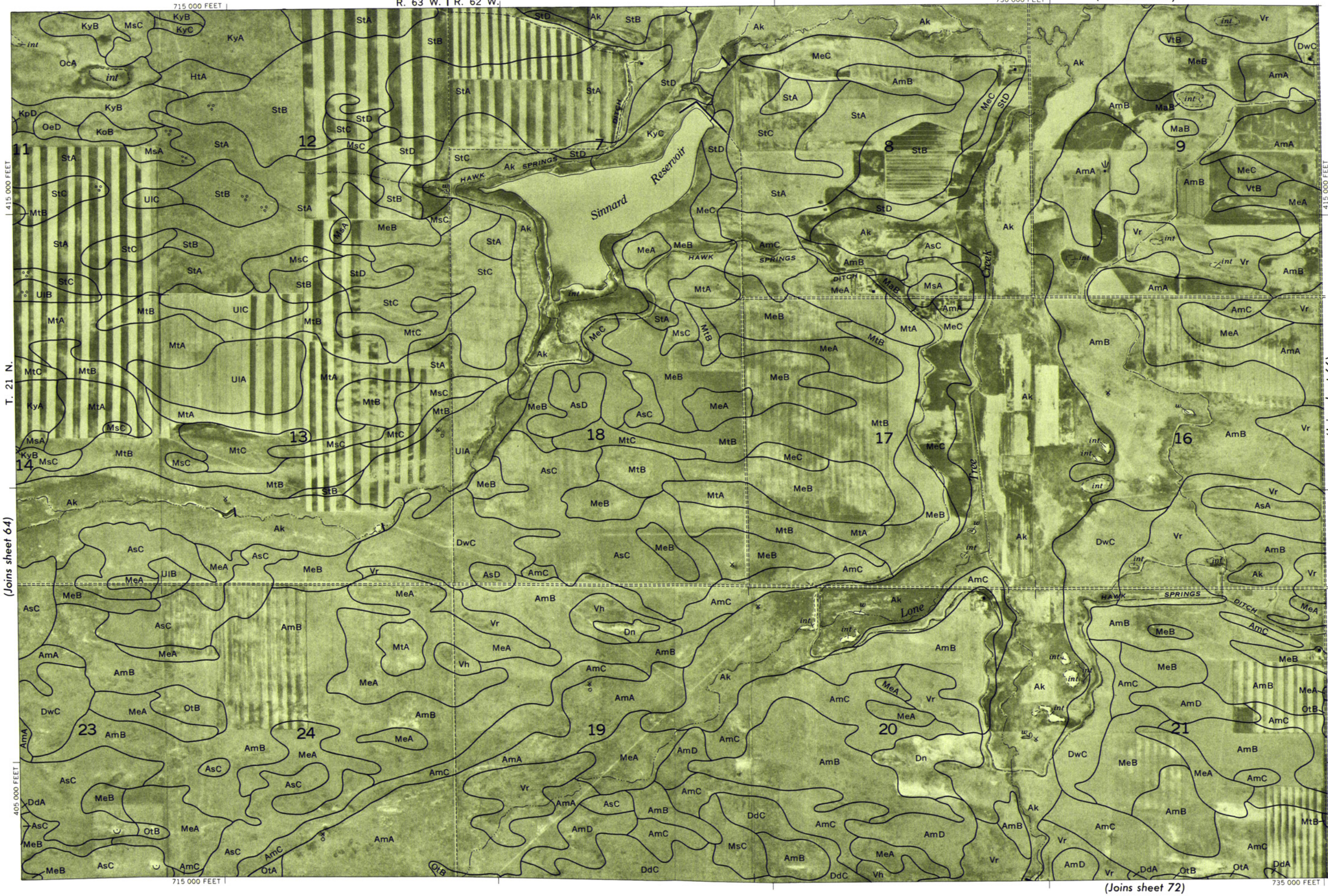
Needle Draw

Jackson Canyon

Needle Rock

Hunter Ranch

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

R. 62 W. | R. 61 W.

T. 21 N.

735 000 FEET

755 000 FEET

740 000 FEET

415 000 FEET

405 000 FEET

(Joins sheet 59)

(Joins sheet 65)

(Joins sheet 67)

(Joins sheet 73)

Scale 1:20 000

1 Mile

5 000 Feet

1 000 0 0 1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1

10 11 12 7 8

15 14 13 18 17

22 23 24 19 20

1

HUGHES DITCH

SCHWAB DITCH

UNION PACIFIC SIPHON

HAWK SPRINGS DITCH

Horse Creek

Hawk Springs

AmA AmB AmC AmD Ak AsA AsC AsD BgB DdA DdC DwA DwC HaA MaB MeA MeB MeC MtA MtB OtA OtB StA StC UlA UlB VtB Vh Vr Gu int w

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

(Joins sheet 60)

760 000 FEET

780 000 FEET

R. 61 W.

T. 21 N.

415 000 FEET

405 000 FEET

(Joins sheet 66)

(Joins sheet 68)

(Joins sheet 74)

8 9 10 11 12

17 16 15 14 13

20 21 22 23 24

Creek

Dry

Draw

N

1 Mile

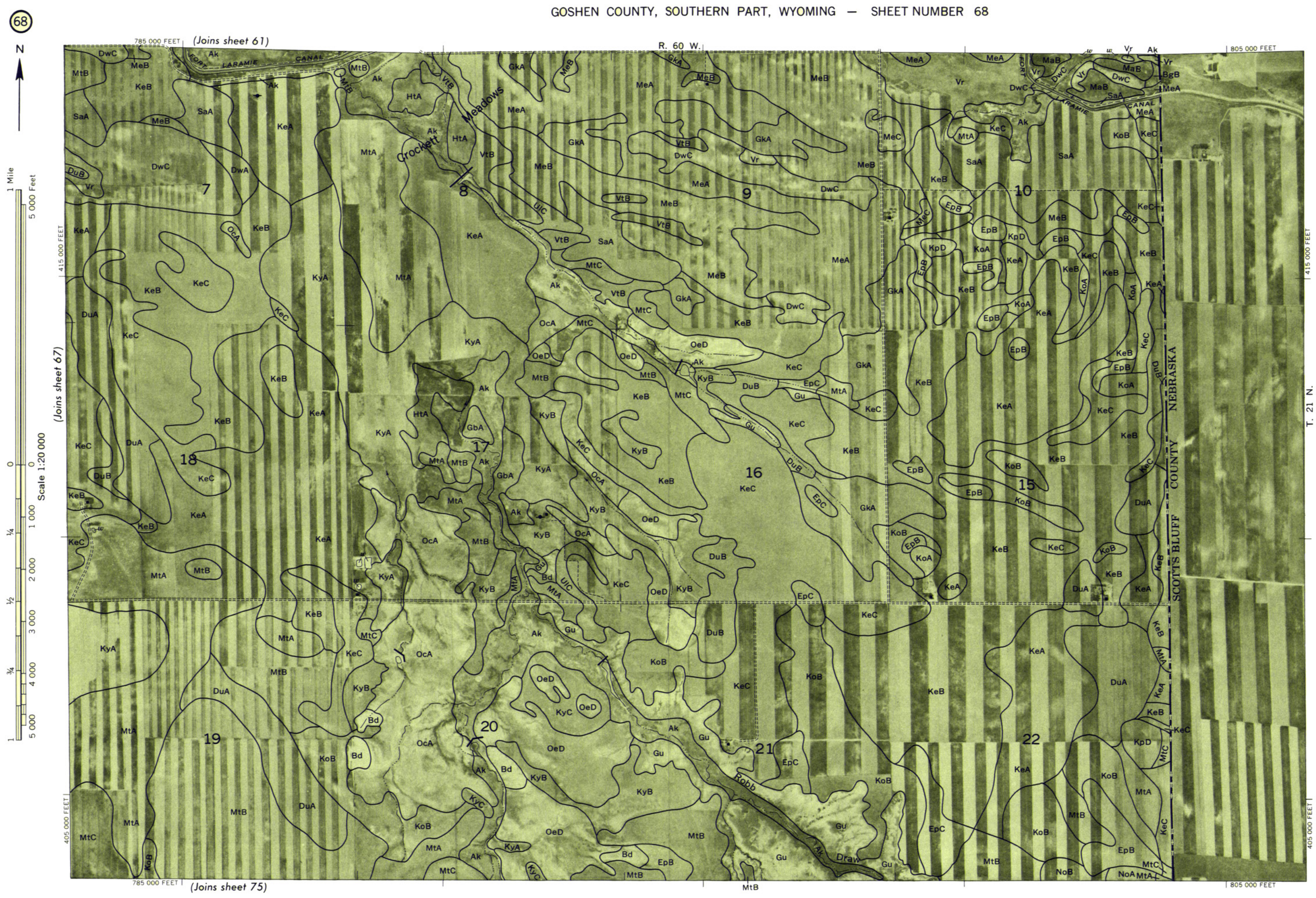
5 000 Feet

Scale 1:20 000

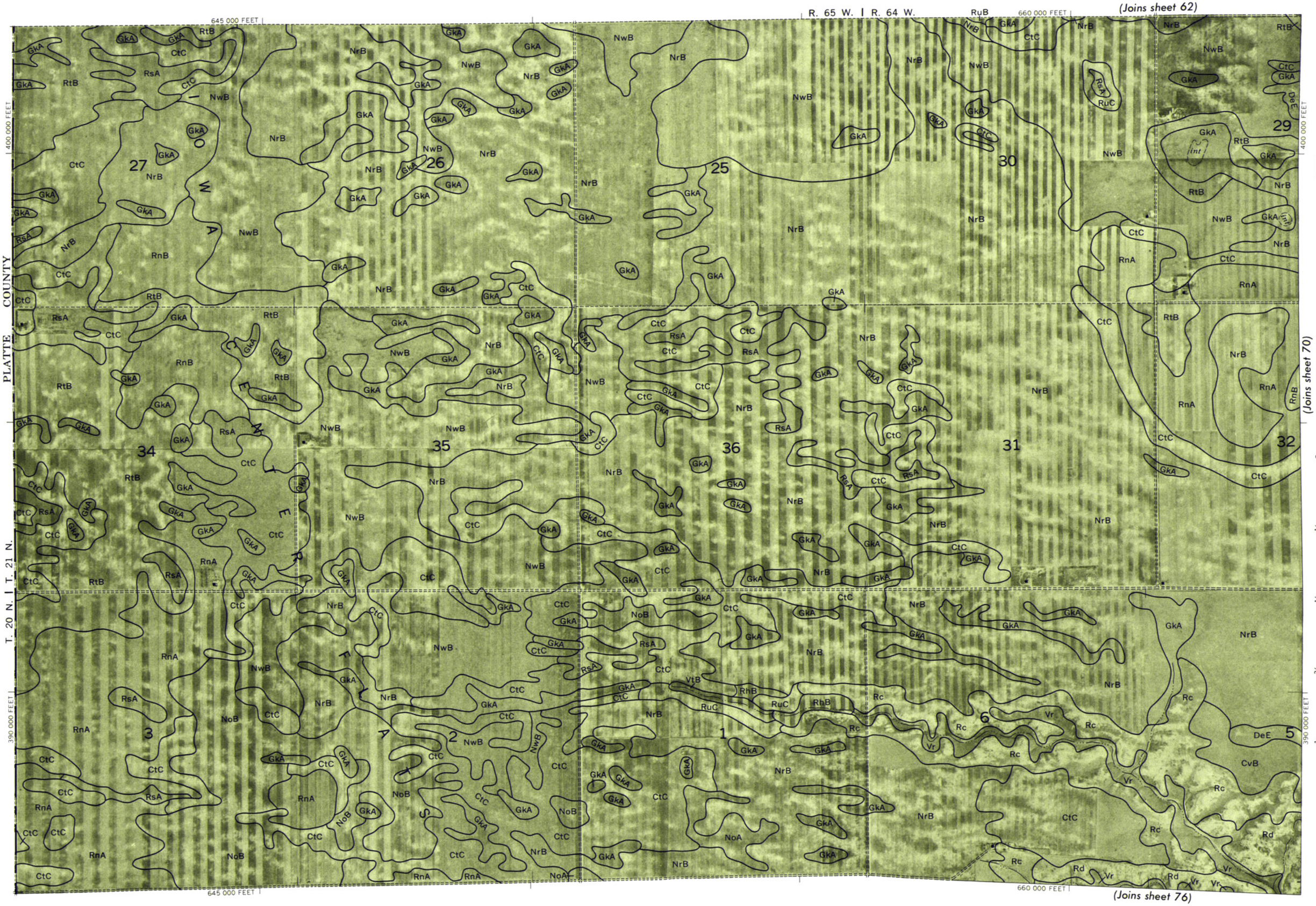
0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 7

7

N

735 000 FEET

755 000 FEET

560 000 FEET

550 000 FEET

R. 62 W.

T. 25 N. | T. 26 N.

(Joins inset, sheet 6)

(Joins sheet 6)

(Joins sheet 12)

SIPHON

CANAL

SURVEY

SOIL

DETAILED

INTERSTATE

OF

LIMIT

Creek

Rawhide

27

26

34

35

2

3

Ak

MtA

BoA

ChC

MaB

DdC

Vh

ChB

BfB

HaA

BoB

BgB

HnA

Vr

DdA

1 Mile

5 000 Feet

Scale 1:20 000

0

¼

½

¾

1

1 000

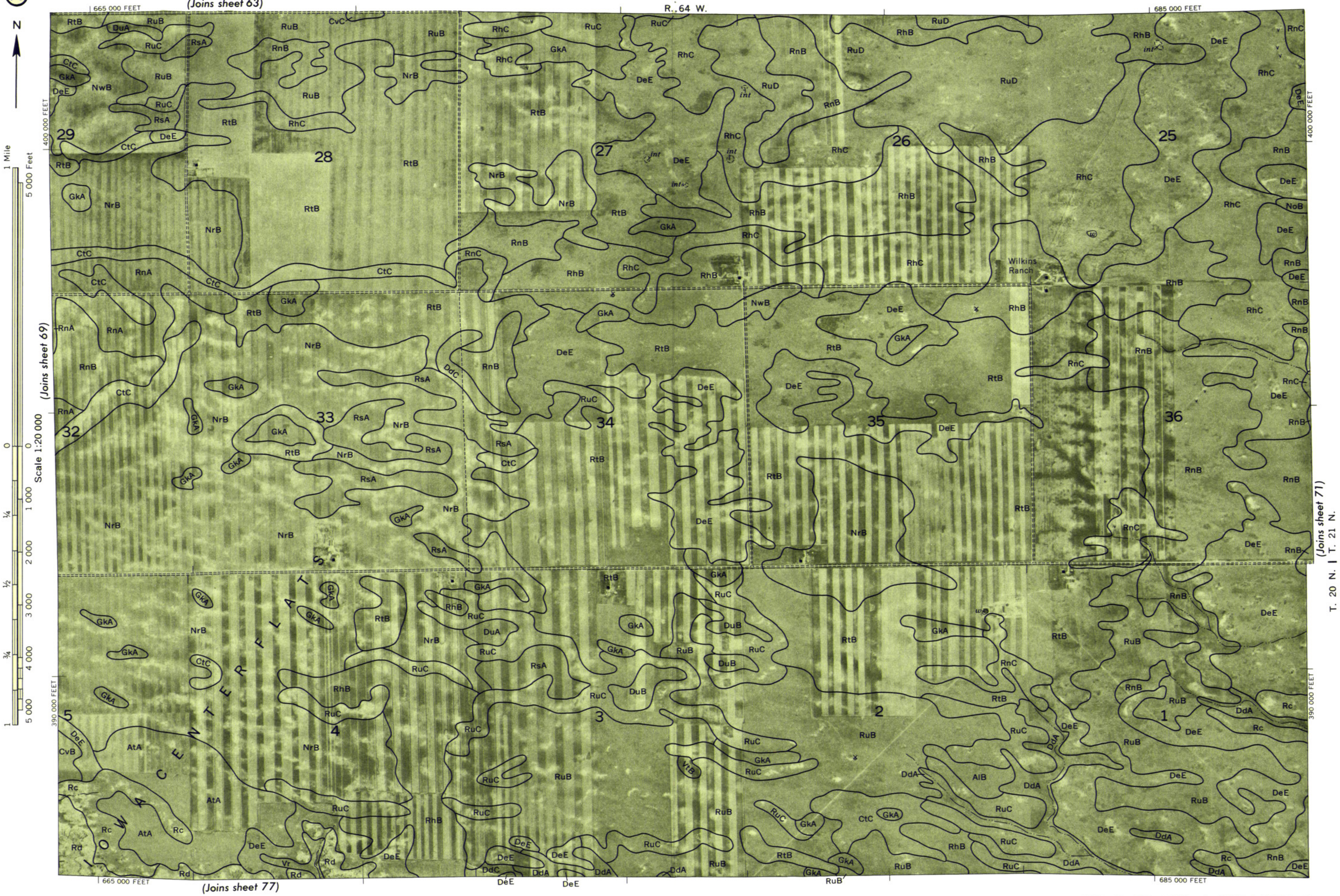
2 000

3 000

4 000

5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

R. 63 W.

690 000 FEET

710 000 FEET

400 000 FEET

390 000 FEET

T. 21 N.

T. 20 N.

(Joins sheet 64)

(Joins sheet 70)

(Joins sheet 72)

(Joins sheet 78)

30 29 28 27 26

31 32 33 34 35

6 5 4 3 2

Lone Tree Canyon

Lone Tree Creek

N

1 Mile 5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

R. 63 W. | R. 62 W.

(Joins sheet 65)

715 000 FEET

735 000 FEET

400 000 FEET

390 000 FEET

N

Scale 1:20 000

1 Mile

5 000 Feet

1 000 Feet

2 000 Feet

3 000 Feet

4 000 Feet

5 000 Feet

Lone Tree Creek

26 25 30 29 28

35 36 31 32 33

2 1 6 5 4

T. 20 N. | T. 21 N.

(Joins sheet 71)

(Joins sheet 73)

(Joins sheet 79)

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 73

73

N

R. 62 W. | R. 61 W.

T. 21 N. | T. 20 N.

740 000 FEET

755 000 FEET

400 000 FEET

390 000 FEET

(Joins sheet 72)

(Joins sheet 66)

(Joins sheet 74)

(Joins sheet 80)

Duroc

HAWK SPRINGS

UNION PACIFIC

Horse Creek

SPRINGS DITCH

1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 74

74

N

(Joins sheet 67)

R. 61 W.

760 000 FEET

780 000 FEET

400 000 FEET

390 000 FEET

(Joins sheet 73)

(Joins sheet 75)

(Joins sheet 81)

T. 20 N. | T. 21 N.

McMillan Reservoir

Zenar Springs

Dry Creek

Dry Draw

Horse Creek

Bear Creek

Walker Canyon

Clay Canyon

Kinkaid Draw

UNION PACIFIC

29 28 27 26 25

32 33 34 35 36

5 4 3 2 1

Scale 1:20 000

1 Mile

5 000 Feet

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

(Joins sheet 68)

785 000 FEET

R. 60 W.

805 000 FEET

400 000 FEET

T. 21 N.

T. 20 N.

390 000 FEET

(Joins sheet 74)

(Joins sheet 82)

Robb Draw

Seth Smith Draw

Double Hump

McCompsey Canyon

NEBRASKA

SCOTTS BLUFF COUNTY

N

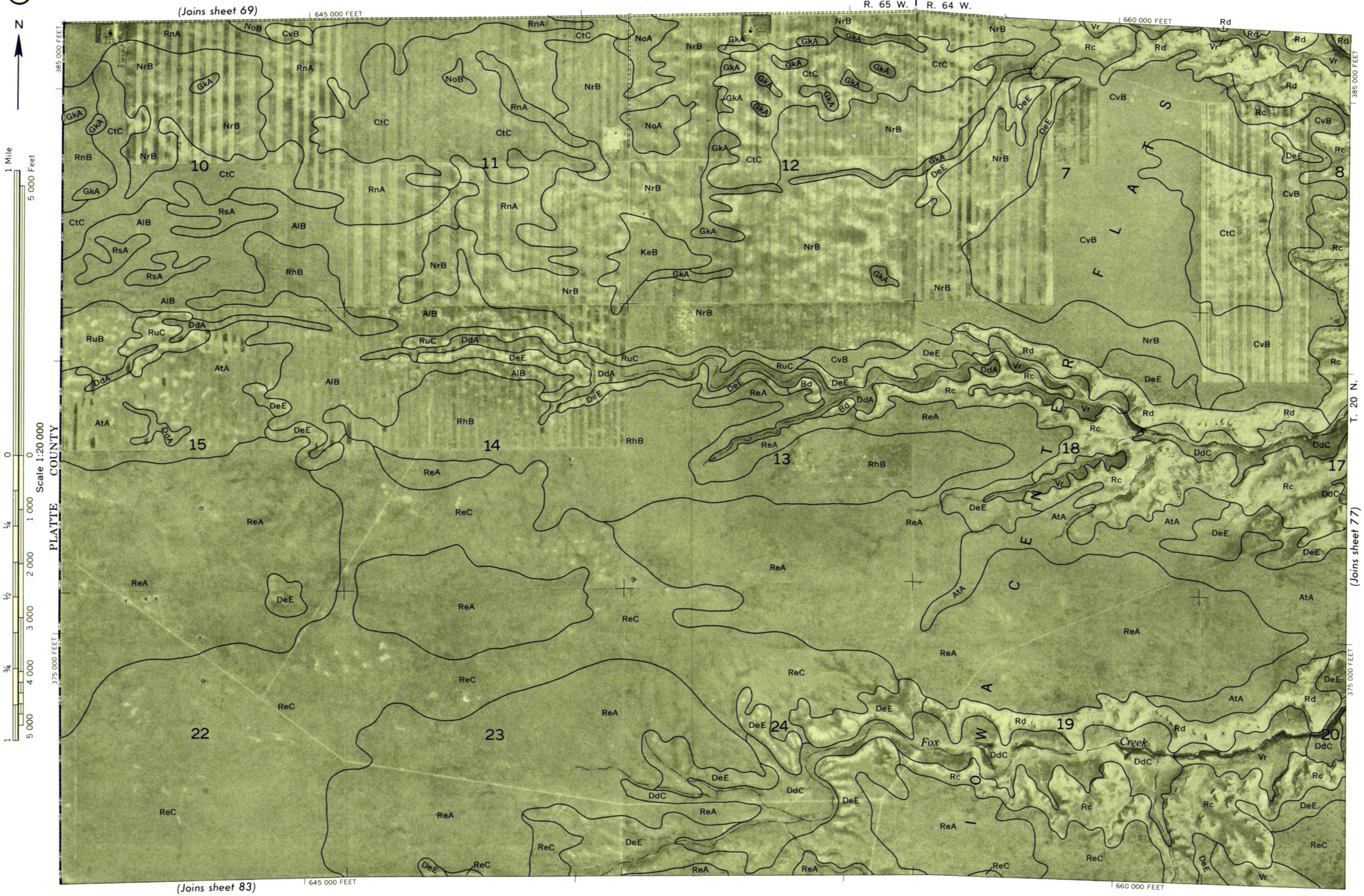
1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 76



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

77

(Joins sheet 70)

665 000 FEET

685 000 FEET

R. 64 W.

385 000 FEET

375 000 FEET

T. 20 N.

(Joins sheet 76)

(Joins sheet 78)

(Joins sheet 84)

N

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Fox Creek

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

(Joins sheet 71)

690 000 FEET

RnB R. 63 W.

710 000 FEET

385 000 FEET

T. 20 N.

(Joins sheet 77)

(Joins sheet 79)

375 000 FEET

Scale 1:20 000

1 Mile 0 ¼ ½ ¾ 1

5 000 Feet 0 1 000 2 000 3 000 4 000 5 000

Fox Creek

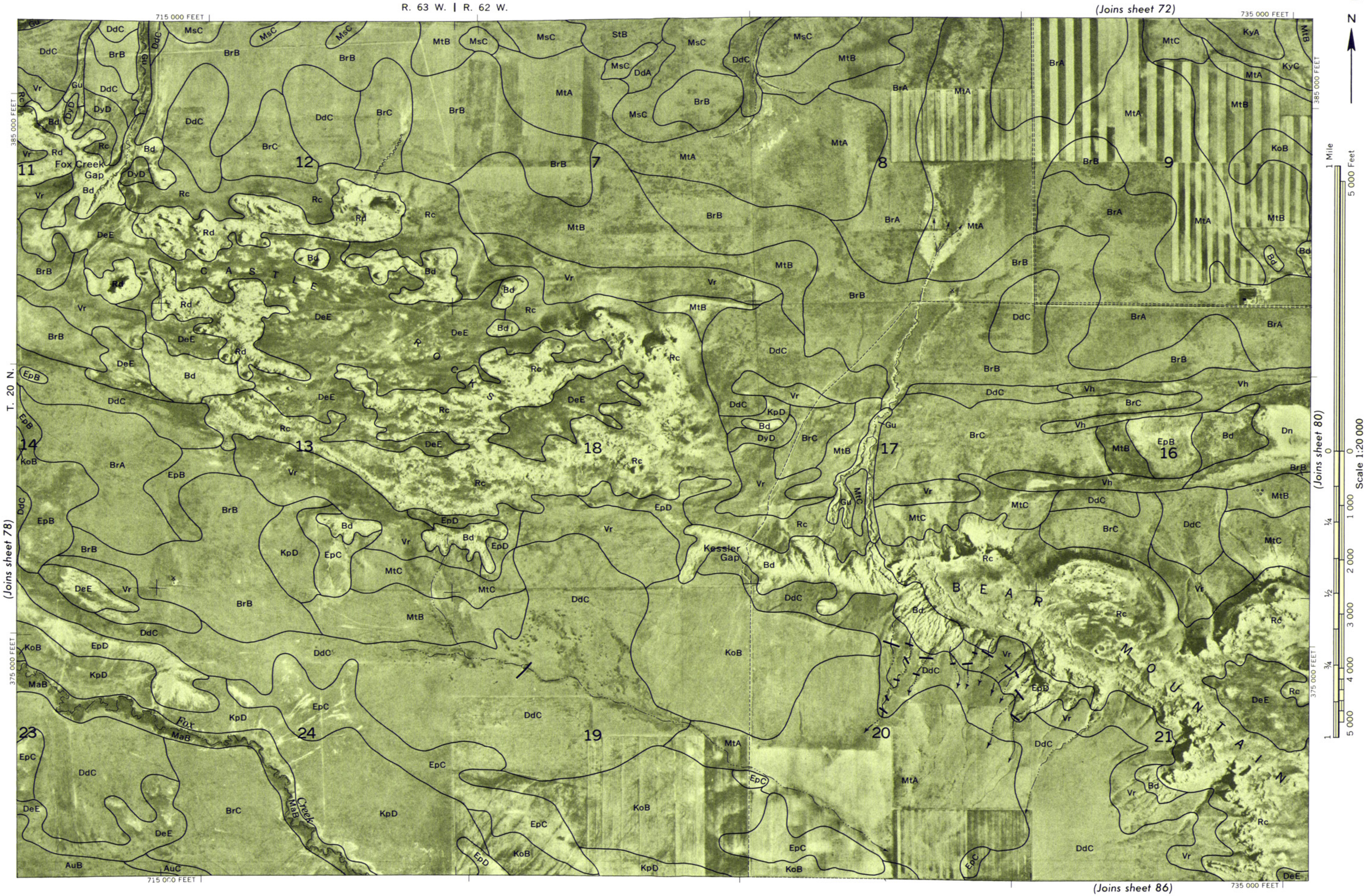
(Joins sheet 85)

690 000 FEET

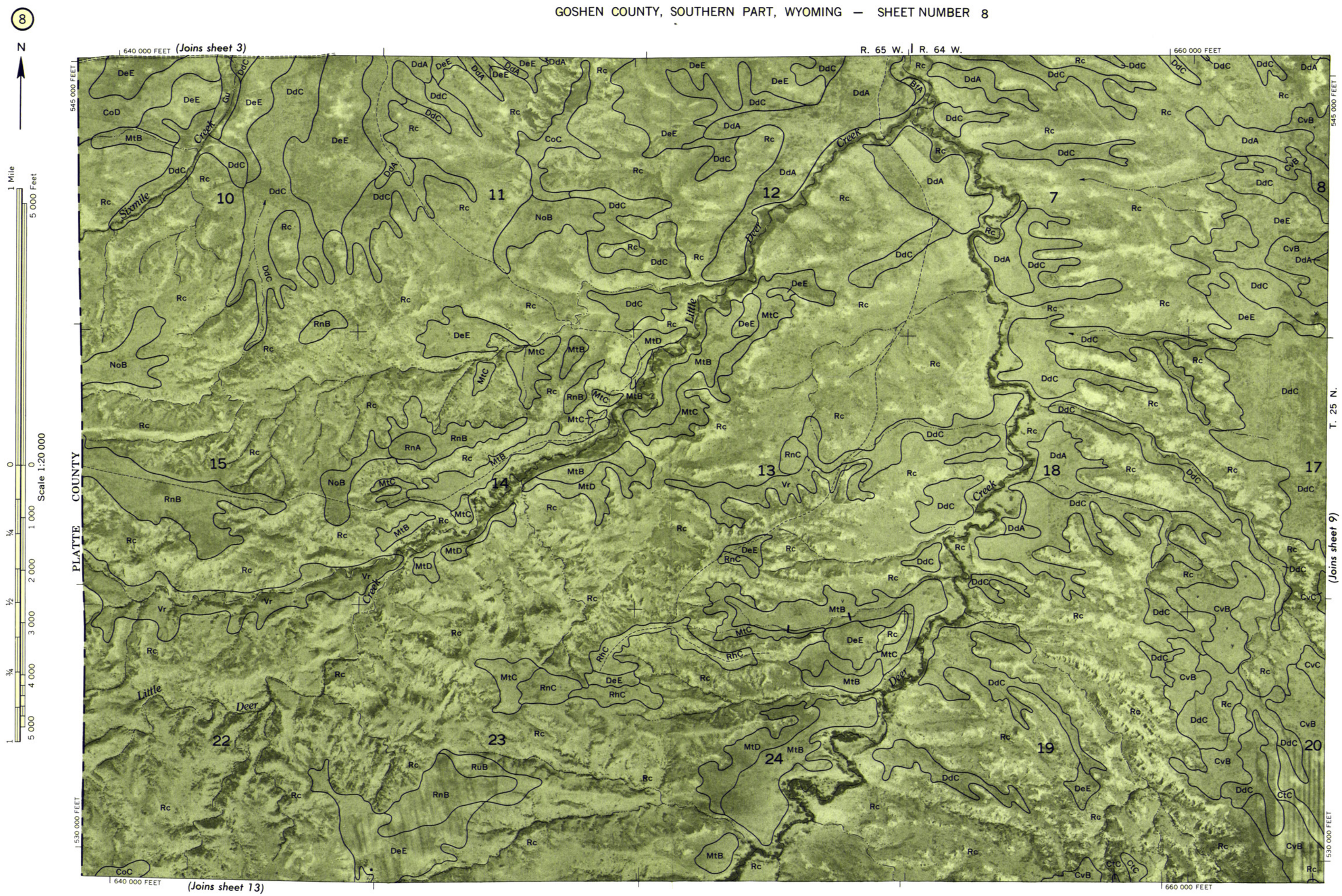
710 000 FEET

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 79



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

(Joins sheet 73)

740 000 FEET

R. 62 W. | R. 61 W.

755 000 FEET

385 000 FEET

N

1 Mile

5 000 Feet

0 0

Scale 1:20 000

1/4 1 000

1/2 2 000

3/4 3 000

1 4 000

5 000

(Joins sheet 79)

(Joins sheet 81)

T. 20 N.

375 000 FEET

(Joins sheet 87)

740 000 FEET

755 000 FEET

BEAR MOUNTAIN

Creek

Horse

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

81

760 000 FEET

R. 61 W.

780 000 FEET

(Joins sheet 74)

385 000 FEET

375 000 FEET

T. 20 N.

(Joins sheet 80)

(Joins sheet 82)

(Joins sheet 88)

N

1 Mile

5 000 Feet

Scale 1:20 000

HAWK SPRINGS RESERVOIR

SIXTY SIX MOUNTAIN

The Point

Horse Creek

HAWK SPRINGS DITCH

UNION PACIFIC

Beaver Creek

Walker Canyon

Clay Canyon

Nichols Canyon

intermittent

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

785 000 FEET

(Joins sheet 75)

R. 60 W.

805 000 FEET

385 000 FEET

T. 20 N.

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 81)

SIXTY SIX MOUNTAIN

NEBRASKA

SCOTTS BLUFF COUNTY

BANNER COUNTY

NEBRASKA

Driscoll Canyon

McCompsey Canyon

Devils Armchair

Box Elder Draw

Spring Draw

Stemler Draw

East Spring Draw

State Line Springs Draw

375 000 FEET

(Joins sheet 89)

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 83

83

N

R. 65 W. | R. 64 W.

645 000 FEET

660 000 FEET

370 000 FEET

355 000 FEET

(Joins sheet 76)

(Joins sheet 84)

(Joins sheet 90)

T. 20 N. | T. 19 N.

PLATTE COUNTY

LARAMIE COUNTY

ReC ReA DeE DdA DcE DdC CvB Vr Vh RhB Rc

27 26 25 30 29 34 35 36 31 32 3 2 1 6 5

1 Mile

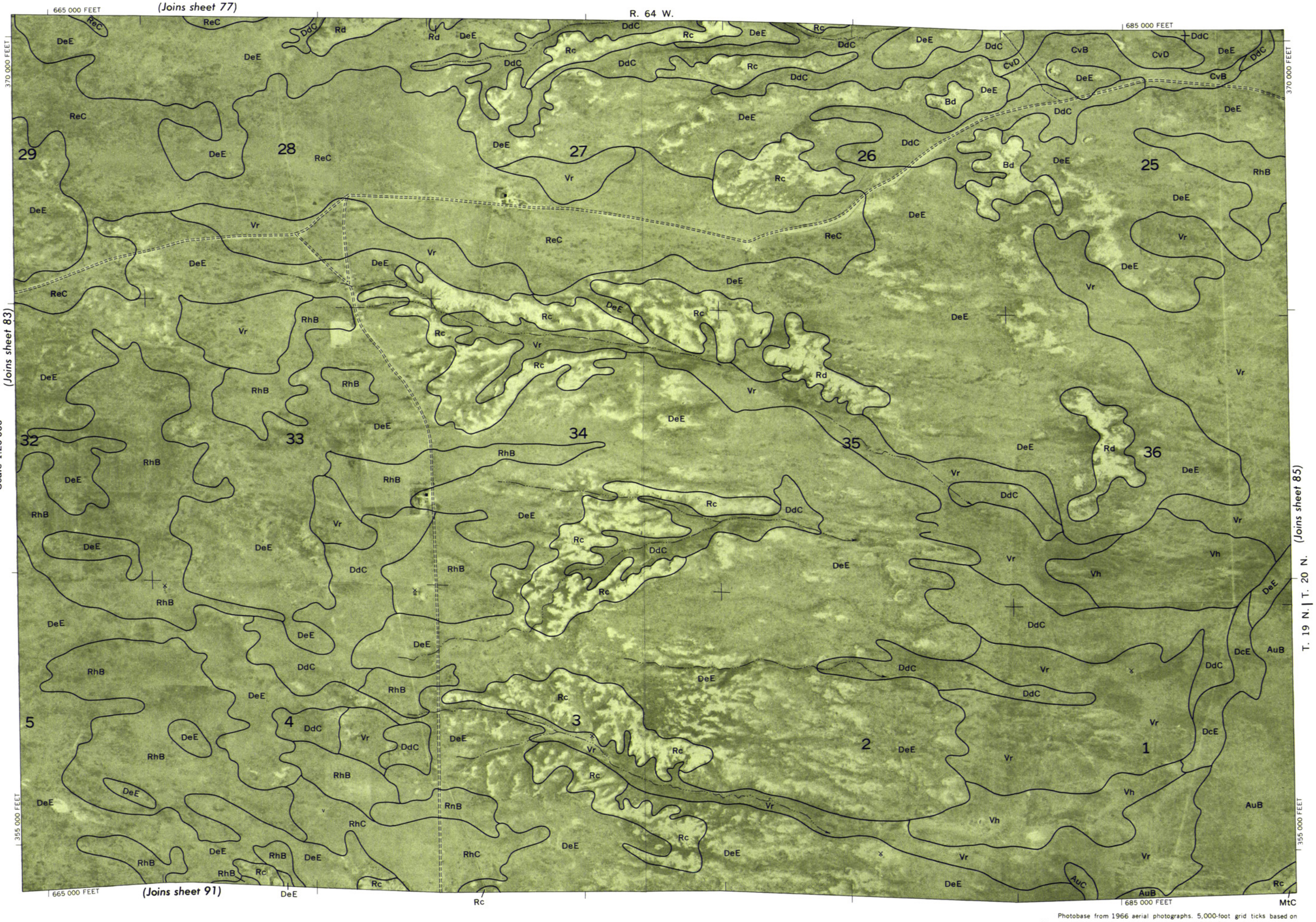
5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 85

85

R. 63 W.

690 000 FEET

710 000 FEET

370 000 FEET

355 000 FEET

T. 19 N. | T. 20 N.

(Joins sheet 84)

(Joins sheet 78)

(Joins sheet 86)

(Joins sheet 92)

N

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

DIAMOND FLAT

Bear Creek

29 28 27 26

30 31 32 33 34 35

6 5 4 3 2

DeE DdC MaB RhB RhC Bd Vr Vh AuB AuC CvC MtB MtC GbA Rc Rd

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

86

N

R. 63 W. | R. 62 W.

T. 19 N. | T. 20 N.

(Joins sheet 79) 715 000 FEET

735 000 FEET

370 000 FEET

(Joins sheet 85)

(Joins sheet 87)

355 000 FEET

(Joins sheet 93) 715 000 FEET

735 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 0 1/4 1 000 1/2 2 000 3/4 4 000 1 5 000

D I A M O N D F L A T

Fox Creek

Bear Creek

Dater Creek

Badger Branch

KESSLER DITCH

BEAR CREEK DITCH

BEAR DITCH

25 26 27 28 29 30 31 32 33 34 35 36 1 2 3 4 5 6

AuB AuC BrA BrB BrC Bd CoC CvD ChB ChC DcE DdA DdC DeE DyD EpB EpC EpD GbA Gu KoB KpD MaB MtA MtB MtC Rc Vr

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

87

740 000 FEET

R. 62 W. | R. 61 W.

755 000 FEET

(Joins sheet 80)

370 000 FEET

(Joins sheet 86)

(Joins sheet 88)

T. 19 N. | T. 20 N.

355 000 FEET

(Joins sheet 94)

N

Scale 1:20 000

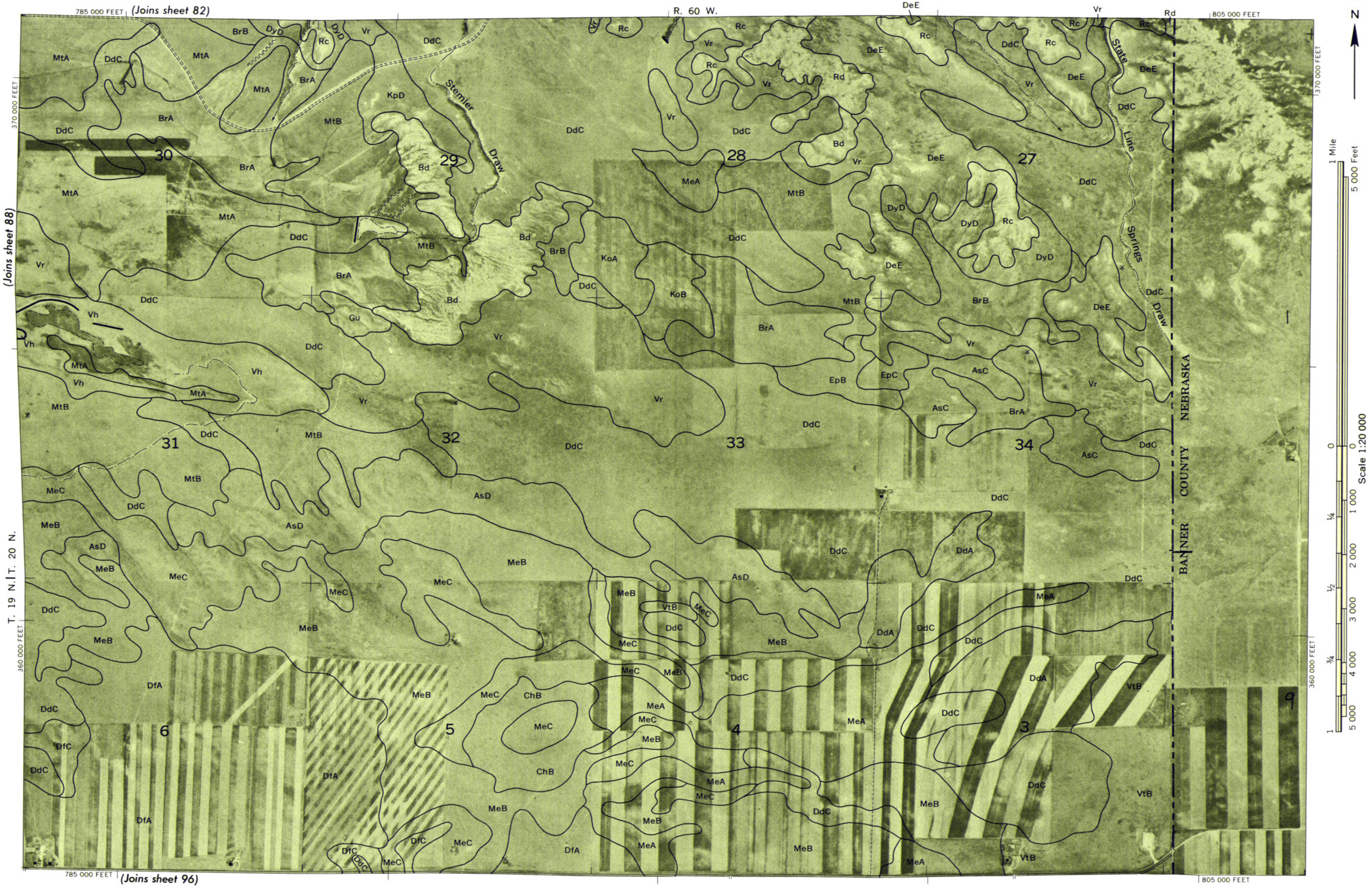
1 Mile

5 000 Feet

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 88

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 9

9

N

R. 64 W.

T. 25 N.

665 000 FEET

685 000 FEET

545 000 FEET

530 000 FEET

(Joins sheet 4)

(Joins sheet 10)

(Joins sheet 8)

(Joins sheet 14)

HARMONY HEIGHTS

Draw

Bovee

1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 90

R. 65 W. | R. 64 W.

N

(Joins sheet 83)

645 000 FEET

660 000 FEET

350 000 FEET

340 000 FEET

T. 19 N.

(Joins sheet 91)

(Joins sheet 97)

LARAMIE COUNTY

Scale 1:20 000

1 Mile — 5 000 Feet

0 — 1/4 — 1/2 — 3/4 — 1

0 — 1 000 — 2 000 — 3 000 — 4 000 — 5 000

10 11 12 7 8 15 14 13 18 17 22 23 24 19 20

Bear Creek · Little Bear Creek · Curly Run

CvB CvC DeE DcE RhB RhC RnA RnB RnC CvD Vr Rc Rd DdC GbA Mu MaB MtA Vh int

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

665 000 FEET

685 000 FEET

R. 64 W.

(Joins sheet 84)

350 000 FEET

340 000 FEET

T. 19 N.

(Joins sheet 90)

(Joins sheet 92)

(Joins sheet 98)

Bear Creek

Rum Spring

8 9 10 11 12 13 14 15 16 17 20 21 22 23 24

N

1 Mile 5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

R. 63 W.

T. 19 N.

690 000 FEET

710 000 FEET

350 000 FEET

340 000 FEET

(Joins sheet 85)

(Joins sheet 91)

(Joins sheet 93)

(Joins sheet 99)

Scale 1:20 000

1 Mile 5 000 Feet

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

Bear Creek Church

Bear Creek

Dater Creek

7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

AuB AuC Rc MtC GbA Rd Ak DdC BrB Bd DeE MtB MtD DdA Vr CvB CvC CvD DdC RnB Bd MtA RhB RuD

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 93

93

R. 63 W. | R. 62 W.

715 000 FEET

735 000 FEET

350 000 FEET

340 000 FEET

T. 19 N.

(Joins sheet 86)

(Joins sheet 94)

(Joins sheet 92)

(Joins sheet 100)

N

1 Mile

5 000 Feet

Scale 1:20 000

Dater Creek

Badger Branch

Morrie Ranch

GRAVEL PIT

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

(Joins sheet 87)

740 000 FEET

R. 62 W. | R. 61 W.

755 000 FEET

1 Mile

5 000 Feet

350 000 FEET

(Joins sheet 93)

Scale 1:20 000

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

T. 19 N.

(Joins sheet 95)

340 000 FEET

(Joins sheet 101)

740 000 FEET

755 000 FEET

Lovercheck Canyon

Gregory Ranch

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

95

N

760 000 FEET

R. 61 W.

(Joins sheet 88)

780 000 FEET

355 000 FEET

350 000 FEET

T. 19 N.

(Joins sheet 94)

(Joins sheet 96)

340 000 FEET

760 000 FEET

(Joins sheet 102)

780 000 FEET

Horse Creek

UNION PACIFIC

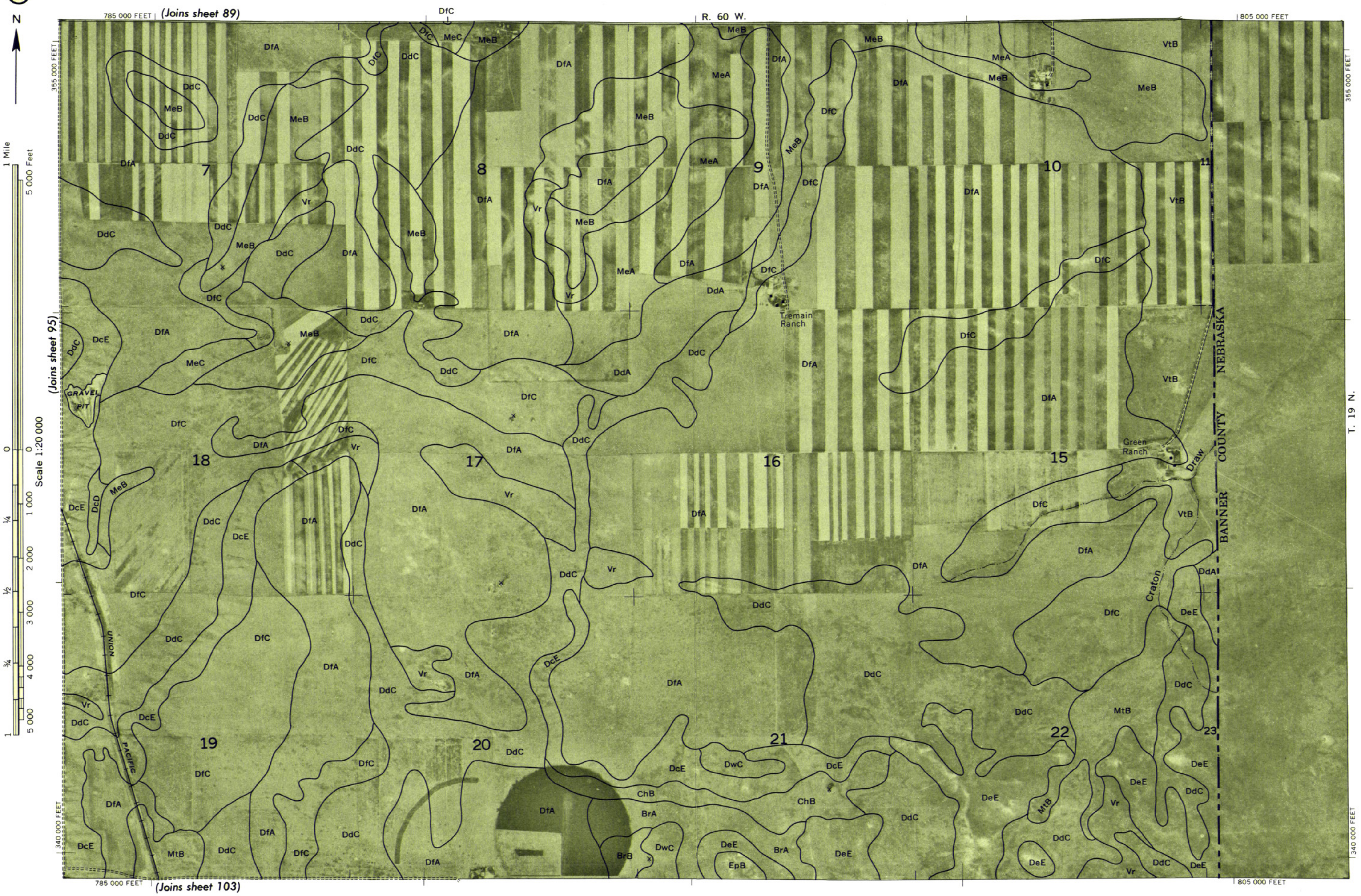
Scale 1:20 000

1 Mile

5 000 Feet

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 96



Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

GOSHEN COUNTY, SOUTHERN PART, WYOMING — SHEET NUMBER 97

97

R. 65 W. | R. 64 W.

645 000 FEET

660 000 FEET

335 000 FEET

325 000 FEET

(Joins sheet 90)

(Joins sheet 98)

T. 19 N.

LARAMIE COUNTY

LARAMIE COUNTY

N

1 Mile

5 000 Feet

Scale 1:20 000

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

N

665 000 FEET

(Joins sheet 91)

R. 64 W.

685 000 FEET

335 000 FEET

T. 19 N.

(Joins sheet 97)

(Joins sheet 99)

325 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

29 28 27 26 25

32 33 34 35 36

CvB RhC DeE DcE Rc RnB DdC CvC CvD ChC RhB RuD MtA DcD RnC DdA

Rocky Hollow

LARAMIE COUNTY

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.

690 000 FEET

710 000 FEET

R. 63 W.

(Joins sheet 92)

335 000 FEET

325 000 FEET

T. 19 N.

(Joins sheet 98)

(Joins sheet 100)

N

Rocky Hollow

LARAMIE COUNTY

Scale 1:20 000

1 Mile

5 000 Feet

Photobase from 1966 aerial photographs. 5,000-foot grid ticks based on Wyoming plane coordinate system, east zone. 1927 North American datum.